CHEMICAL & METALLURGICAL ENGINEERING

Vol. 44 • ESTABLISHED 1902 • No. 12

CONTENTS FOR DECEMBER 1937

McGRAW-HILL PUBLISHING COMPANY, INC.

Publication office, 99-129 N. Broadway, Albany, N. Y., Editorial and executive offices, 330 West 42nd St., New York, N. Y. Cable address: McGrawhill, N. Y.

Branch Offices: 520 North Michigan Ave., Chicago; San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

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Published monthly, price 35 cents a copy. Subscription rates—United States, Canada, Mexico, and Central and South American countries, $3.00 a year. All other countries, $5.00 a year or 20 shillings. Entered as second-class matter September 2, 1936, at the Post Office, Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Member A.B.C. Member A.B.P.

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& METALLURGICAL
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S. D. KIRKPATRICK, *Editor*

DECEMBER 1937

Contact Catalysis in Human Relations

WHEN THE ALLIES took over the German-operated coal mines of the Ruhr and put them under French management, many people freely predicted that serious labor troubles were certain to result. Yet there never was a time when operations ran more smoothly nor when such high production was maintained. One reason for this, we are told, is that the highly trained French engineers who took charge of the operations were experts in human relations. They went down the shafts and into the cross-cuts with the miners, talked to them and with them in their own language, learned their problems and shared in the pride of their accomplishments. One old-timer remarked to Whiting Williams that never in twenty years had his Prussian bosses been down in the workings—let alone had they ever become interested in the personal problems of the men on the job.

Mr. Williams, eminent consultant on industrial relations, told this story to some of us last month in St. Louis at the banquet of the American Institute of Chemical Engineers. His address was a stirring sermon that had as its text the single word "Contract." Therein lies the solution, he feels, for many of our present-day labor problems. Others will be avoided in the future when, through closer contact, chemical engineers and plant managers really learn what is on the worker's mind today.

He asked if by chance there was anything in chemical engineering education or experience that precluded the study of human relations. If that situation exists in our colleges, he feels it should be changed promptly because the sooner the engineer learns that men are not machines nor labor a commodity, the better off will be our industries when these engineers assume responsibility.

"The one trouble today," observed Mr. Williams, "is that the American employer has gotten too far away from his men. He has been looking for some system, some formula, some law, some compulsion, some method that would relieve him of the disagreeable necessity of playing fair with the individual worker."

That indictment is, of course, drawn too broadly to fit all of chemical industry, yet it is a warning that must be heeded. The labor leader would have us believe—and he has apparently convinced the legislator—that there is an impassable gulf between employer and employee which unionization alone can bridge. But he argues from a false premise. There need be no such gap if management through intimate contacts can anticipate and take care of the small grievances and misunderstandings before they grow into serious complaints and become the basis for collective labor disputes. "I have become convinced," continued Mr. Williams, "that the typical worker does not go outside and bring in the labor leader unless he has become more or less convinced that there is no other way to get his chestnuts out of the fire of discontent. And I submit, if that is true, that the whole outlook for the future is more hopeful."

This confirms the experience of several of our chemical industries. It means that the labor organizer finds tough sledding in those industries in which the worker is given true security of employment, where he finds self-respect and satisfaction in his job and has an employer who plays fair because he appreciates and understands the viewpoint of the worker. Much of this comes back to that single word "Contact"—the catalyst for promoting better relations between management and men, between engineer and laborer.

From an EDITORIAL VIEWPOINT

DEEDS, NOT WORDS, NOW!

WASHINGTON is confronted with economic problems that appear quite as distressing to it as those faced in the dark days of 1932. Congress is sorely puzzled, but, nevertheless, seems to be sincerely interested in getting business back again on the road to recovery.

During visits "back home" this summer, many of our legislators came into close touch with actual facts and conditions that convinced them that their job is not to rubber-stamp any more half-baked programs of social and industrial reforms. Perhaps they are not willing to say as much—at least not yet and in the face of Executive Excommunication—but it is significant that they are giving more earnest thought to tax revision than to some of the pet measures in the presidential program. Therein lies the key to unlock a lot of forces that are sorely needed for business recovery.

Directly following page 740 of this issue, you will find an editorial insert entitled "Congress Needs *Your* Guidance *NOW*." It presents some thoughtful views on how three changes in our present tax laws would greatly stimulate private enterprise in this country. Please read that editorial, and whether you agree with it or not, take advantage of the post-cards to make your views known to your Congressman. Let's waste no more time or words in telling Washington where we stand on this tax matter. Deeds, not words, are what count. NOW!

LINKING INDUSTRY WITH EDUCATION

FOLLOWING the general pattern set at the University of Cincinnati and the Massachusetts Institute of Technology, Carnegie Tech has formulated a program of cooperative undergraduate education that merits study by chemical engineers. The Westinghouse Electric & Manufacturing Company has appropriated $200,000 to establish a new professorship of engineering and to provide a number—perhaps ten each year—of George Westinghouse Scholarships. Students selected for these will receive an income of $50 per month during a five-year training period—of which four academic years will be spent at Carnegie. The summer months and two college semesters will be spent in the plants and laboratories of the donor.

Chairman Robertson of Westinghouse sees in this program an opportunity to develop well-educated engineers for the electrical industry. President Doherty of Carnegie sees a greater breadth of training to be obtained by combining classroom studies with actual working experience in a large industrial organization. Chairman Frew of the Endowment Fund Committee of Carnegie Tech sees the beginning of a new era of cooperation between industry and education. *Chem. & Met.* sees a fine opportunity for some large and progressive process industry to set up the same sort of program in chemical engineering. There are several first-class educational institutions that would listen mighty attentively.

SULPHANILAMIDE TRAGEDIES

CHEMICAL manufacturers cannot ignore the lessons to be drawn from the tragedies which have followed the distribution of "Elixir Sulphanilamide." This unfortunate episode, which was responsible for at least 73 deaths, is blamed by the Department of Agriculture on a manufacturing house, headed by a graduate doctor (M.D.) and guided by an experienced pharmaceutical chemist. No blame is attached to chemical manufacturers by the Department in their official statement. In fact, the Department states that manufacturers of diethylene glycol, which was improperly used as a solvent in the "elixir," have been at great pains to advise their customers that this chemical should not be used for foods, beverages, or drug preparations intended for internal human consumption.

The manufacture and distribution of new drug preparations without suitable experimentation under controlled conditions to determine the adequacy, the safety, and the proper dosage, is a practice rightly condemned by the Government officials. It seems strange that the medical profession has not already established in the minds of every pharmaceutical house the necessity for this care. It should not be necessary to establish a federal "license control of new drugs to ensure that they will not be generally distributed until

experimental and clinical tests have shown them to be safe for use." It is unfortunate that this conclusion should have become the major recommendation of the Department of Agriculture to Congress —not because precautions are unnecessary, but because the Public Health Service was not suggested as the supervisory agency rather than the Food and Drug Administration.

Perhaps the most unfortunate feature of this whole affair is the possibility that sulphanilamide will fall into disfavor with the medical profession. That synthetic drug seems almost a miracle worker in the case of certain infections caused by bacteria of the "coccus" family. It should not be used carelessly, nor is it a proper one to distribute for self-medication, like aspirin. But it is a drug of great value. Its reputation must not be allowed to suffer unduly. To do so might result in many more deaths from uncontrolled infections than have occurred through uncontrolled distribution of the dangerous "elixir."

Chemical manufacturers have long recognized that they should not market new products in any way which would expose the public, the transportation agencies, or their customers to any new hazards. This responsibility is so widely understood and accepted as to make new recommendations regarding it unnecessary. The important thing is, therefore, to see that chemical salesmen are impressed anew with the need for educating chemical *users* in the proper public policy. An untiring effort to see to it that the uniformed do not venture into fields beyond their skill and competence is a moral if not legal responsibility of chemical industry.

WHO SHOULD BUILD THE MACHINERY?

LONG has the city-gas industry been puzzled by the problem of building industrial gas-burning equipment. The question usually is "Shall utility companies become equipment builders?" Often they do, and equipment companies suffer. Some views recently expressed by an experienced spokesman from Rochester, N. Y., home of one of the most progressive, far-seeing utility-gas enterprises, have a bearing on this situation.

Chemical engineers will be glad to have the conclusions of this experienced contemporary utility group. They will appreciate that with respect to chemical processing equipment there are similar problems. They will agree that "equipment manufacturers should receive our consideration and our orders. . . . The equipment manufacturer is an essential element in our progress."

But those selling chemicals, who cannot find equipment companies ready to build needed apparatus, can also find comfort in Mr. Sullivan's conclusions that at times the proponents of gas (or chemicals) must go into the equipment building business in order to prove experimentally that a development is feasible when apparatus builders are not sufficiently alert to carry on this development themselves.

Apparently it is another case of common-sense cooperation between apparatus men, chemicals maker, and consultants. Each case is a problem in itself, generally a problem easily solved when a real spirit of cooperation prevails.

ET TU, BRUTE?

"WHILE I REGRET to say it, I feel there is no prospect at any time within the next five or six years of any large quantity of corn being used for motor fuel." Thus Secretary of Agriculture Wallace plunges another fatal dagger into the tottering Caesar of chemurgical alcohol. Rightly, however, the Secretary urges continuing study of the further possibilities for the industrial uses of corn. At the same time he warns against anything that would "hold out false hopes to farmers."

Such realistic approach to the economic competition between alcohol and gasoline as is now urged by the Department should be helpful. It should not discourage those who seek, by careful science and well-planned engineering methods, to cheapen the product. The discouragement should not be directed against research, but against exaggerated claims from research.

Alcohol is suffering enough from regulatory efforts that it ill deserves further discouragement. Every new technical advance should be applied as promptly as possible as an offset for the growing cost of meeting state laws and regulatory efforts which are having mushroom growth throughout the United States.

Chairman Ittner of Committee of Award Presents Bronze Plaque to Edgar Monsanto Queeny

MONSANTO RECEIVES 1937 AWARD

FOR CHEMICAL ENGINEERING ACHIEVEMENT

ON DECEMBER 10, the 1937 Award for Chemical Engineering Achievement was formally presented to the Monsanto Chemical Company of St. Louis for its outstanding contribution in developing the large-scale production and utilization of elemental phosphorus. Presentation was made at a dinner in the University Club in New York City attended by a number of the leaders of chemical industry and the chemical engineering profession. The ceremonies were broadcast over WJZ and the Blue Network of the National Broadcasting Company.

Sidney D. Kirkpatrick, editor of *Chem. & Met.* and toastmaster of the dinner, explained the origin of this unique award which is presented primarily "to encourage a broader participation by the chemical engineer in the affairs of the process industries." The first award in 1933 was to the Carbide & Carbon Chemicals Corporation, for its development of a synthetic organic chemical industry based on petroleum and natural gas. The second award in 1935 was to the Organic Chemical Department of E. I. du Pont de Nemours & Co., Inc., for "meritorious achievement in the successful large-scale production of synthetic rubber, synthetic camphor and a variety of other essential organic chemicals and dyestuffs." The work of the Monsanto Chemical Company which was recognized by the Committee of Award was described in an unusual article in the November issue of *Chem. & Met.* (see pp. 643-650).

Dr. Martin Hill Ittner, Chairman of the Committee of Award, presented the bronze plaque to Edgar Monsanto Queeny, president and son of the founder of the Monsanto Chemical Company. Extracts from the addresses of presentation and acceptance appear on these pages. The program was concluded by an informal talk by Gaston DuBois, vice president in charge of research and development, whose subject was "What's Ahead for Phosphorus."

The Committee of Award consists of nine representative leaders of the chemical industry and profession as follows: Chairman, Dr. Martin H. Ittner; President of the American Institute of Chemical Engineers and Chief Chemist of Colgate-Palmolive-Peet Co. of Jersey City, N. J.; Dr. F. M. Becket, Past-President, American Institute of Mining and Metallurgical Engineers, President, Union Carbide & Carbon Research Laboratories; Harry L. Derby, Chairman of the Executive Committee of the Manufacturing Chemists' Association, President, American Cyanamid & Chemical Corp.; Albert E. Marshall, Past-President, American Institute of Chemical Engineers, Consulting Engineer in New York City; Dr. Gustavus J. Esselen, President, Gustavus J. Esselen, Inc., Chemical Consultants, Boston; Walter A. Schmidt, Former Director, American Chemical Society, President, Western Precipitation Co., Los Angeles; Dr. Edward R. Weidlein, President, American Chemical Society, Director of Mellon Institute of Industrial Research; Professor Alfred H. White, Past-President, American Institute of Chemical Engineers, head of the department of Chemical & Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.; Frederick C. Zeisberg, President-Elect, American Institute of Chemical Engineers, Development Department, E. I. du Pont de Nemours & Co.

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Presentation

By DR. MARTIN HILL ITTNER

CHAIRMAN, COMMITTEE OF AWARD

CHEMICAL ENGINEERING, in the memory of many of us, has grown from a queer hybrid mixture of chemistry and mechanics into a well-defined and recognized branch of the engineering profession. The heads of our schools and colleges report that it has already gone ahead of several of the older divisions in engineering education. The reason for this is largely because the chemical engineer has been able to adapt himself, and in turn to help industry in adapting itself, to a rapidly changing world of technology. Literally, he has become "the man of the hour."

The work of the chemical engineer in industry is seldom as spectacular as that of his chemical partner in the research laboratory. As a result, it is usually the brilliant research chemist who receives the multiplicity of medals, prizes and honors from his fellow scientists. And it is he on whom the public quite naturally bestows the credit for most of our great achievements in science and industry. Yet those of us who know the facts realize that at least a part of this credit is due to the eminently practical work of the engineer in translating the miracles of the test-tube into the profitable production processes of the plant.

This calls for teamwork—not alone between the chemist and the engineer, but among all the many men of modern industry represented in production, distribution, management and administration. In short, it calls for the sort of group effort and achievement for which this unique Award was created. Its purpose is to encourage a broader participation by the chemical engineer in the affairs of the process industries—and it attempts to accomplish this objective by according recognition to that company which, in the opinion of the Committee of Award, has made the most meritorious contribution to the advance of the chemical industry and profession.

This year your Committee has been most favorably impressed with the important work of the Monsanto Chemical Company in developing the large-scale production and utilization of elemental phosphorus. This is an achievement of which the whole chemical engineering profession is justly proud. It typifies the sort of accomplishment that can result only from well-coordinated teamwork on the part of an efficient chemical engineering organization.

Mr. Queeny, in the opinion of our Committee of Award, the Monsanto Chemical Company has contributed a great advance to our industry and profession. We feel that that advance has been made possible only because your company has long recognized the work of your chemical engineers and has encouraged them to participate broadly in all the affairs of your business. Your management has seen the wisdom and has had the courage to plough back a substantial proportion of your earnings into expenditures for research and development. This, more than anything else, in our opinion, has resulted in the present achievement which holds such great promise for the future of American industry and the American public. Therefore I deem it a high honor to present you with this bronze plaque that symbolizes this Award for Chemical Engineering Achievement.

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Acceptance

By EDGAR MONSANTO QUEENY

PRESIDENT, MONSANTO CHEMICAL CO.
ST. LOUIS, MO.

IN EXPRESSING DEEP APPRECIATION of this Award, I am speaking for everyone of our employees, who has had a part in the development and utilization of elemental phosphorous, which has received such valued recognition from *Chemical & Metallurigcal Engineering*. This achievement has been made possible by the men and women in our organization—scientists and engineers, laborers and executives, who have worked side by side,— enthusiastically, tenaciously, cooperatively—all inspired by the vision of a goal to be reached—not asking what their reward would be.

In striving for achievement, risk must be accepted, failures, disappointments, and financial loss must be counted upon, but each success brings encouragement to work toward new accomplishments, each success means greater opportunity for the individuals who have already proved their abilities—new opportunity for self-respecting jobs in construction, operation and distribution, and new opportunity for profitable investment.

It is regrettable that uninformed critics of American industry cannot comprehend its honesty of purpose, the enthusiasm and teamwork of its organization, as well as the risks and many practical difficulties involved in manufacture. It is unfortunate for all Americans that the philosophy of these critics influences public opinion to surround industry with hampering restrictions and burdensome and punitive taxation, which has retarded its progress. Today's industrial achievements are dwarfed by tomorrow's possibilities, and today's standards of wages and of living are susceptible to an infinite, orderly advance. This advance, however, can be obtained only through industry's conquest of the great possibilities of the unknown.

The record of the progress made by the chemical industry in providing products that promote the comfort, health and happiness of human beings has been outstanding, and we are proud to have made a contribution to that accomplishment. As a member of this progressive industry, we of Monsanto Chemical Company accept the challenge to continue additional contributions to still higher standards of living.

Receiving this Award for Chemical Engineering Achievement in the name of my company moves me deeply. The foresight and the willingness to contribute a considerable share of the profits of the company to research, which has made our phophorus development possible and worthy of this tribute, was due to my father's inspiration. He would have just pride, if he were here tonight, in this recognition of this company's share in the progress which chemistry has made to human health, wealth and enjoyment.

The modern distillery of Hiram Walker & Sons at Peoria, Ill.

How Improved Equipment Can Help the Modern Distillery

By L. P. WEINER

SUPERINTENDENT
HIRAM WALKER & SONS,
PEORIA, ILL.

THE DISTILLING INDUSTRY of today has only one characteristic in common with the industry of pre-prohibition days—the basic processes are similar. The technical control of operation that has entered this field has produced an entirely new set of conditions and their attendant problems. No longer is the modern distillery (or brewery) a place for one-man master-mind control. The picturesque master-distiller or brew-master reigned completely over every function of plant operations from the purchasing of raw materials to bottling and shipping. Today's distilling industry, like other modern industrial operations, is departmentalized, each of the departments being supervised by a specialist.

Changes in the industry were wrought overnight. The problems involved in changing methods of operation and making use of engineering developments occurred much more gradually in other industries. For this reason the distilling industry is outstanding in its needs for a better understanding between engineering and operating staffs, and manufacturers of equipment. Many manufacturers are supplying, in good faith, types of equipment and of materials which were satisfactory for the old distilling needs, but which are not suitable for present-day operations. The truly modern distillery has been designed by distillery engineers and not according to the wishes of a master-distiller.

The basic raw materials for distillery operations are grains. Together with yeast and water, they go to make up the ferment from which the whiskey is eventually distilled. The old slow and wasteful methods of grain unloading have given way to the more efficient, rapid and sanitary method making use of pneumatic conveyors. Since the grain itself does not pass through the exhausters, they may be constructed of standard materials. The conveyors are generally made of flexible metallic tubing, however, they wear out rapidly due to the abrasion from the grain. Rubber tubes are somewhat more successful, but under certain conditions, static electricity is

developed which is an undesirable condition to foster near combustible dust, although a properly equipped grain unloading department should have little dust.

Because grain is an expensive material and government regulations require that distillers account for all the grain received, the accurate weighing of grain as it is received is important. Of course, this can be accomplished by track scales, but the procedure generally used is that of weighing the grain into the building either through batch hopper scales or continuous weighing scales. There are no unusual problems in this connection except the abrasion from the grain. However, if electrically operated or electrically recording scales are used, they should conform to the Underwriters' requirements for Class 2, Group G locations.

An Ideal Bin for Grain Storage

Some distilleries are still using wooden bins for grain storage but these are unsanitary and encourage contamination of the grain which affects the product. They are being replaced more and more by concrete bins or welded steel bins. In either case, it is most important that the interior surfaces are thoroughly curved and that no crevices are present to collect grain or debris. There is still an opportunity for the development of more satisfactory interior coatings that prevent the clinging of grain dust to the steel or concrete bins. The latter must necessarily be made water-tight in order to prevent sweating and consequent molding of the grain. There is need for a simple, easily operated valve for the bottoms of the hoppers—one that will be dust-tight and capable of being dis-assembled quickly for the many cleanings necessary in a properly operated distillery.

Before the grain can be "mashed" for fermentation, it must be ground into a meal. This is usually accomplished by attrition, burr or roller mills, the last being the favorite because it accomplishes a more nearly true cutting rather than a grinding or tearing action. These mills are generally three-high-mills, that is, three pairs of rolls arranged each pair above the other so that grinding is done in three gradual reductions thus entailing a minimum of meal heating. Uniformity of grinding is one of the most important features of this operation as it affects not only the yield but the quality. Although only a few distillers have roll grinding and corrugating equipment, it should not be difficult to convince most of them that such equipment could be profitably installed. For the smaller plants there is a crying need for low-priced grinding and corrugating equipment.

From the mills, the meal is dropped or conveyed into bins, depending upon the physical arrangement of the building. Mills are heavy and are generally located on the lower floors of the structure, and the meal is conveyed from them to bins on the floors above. This arrangement permits use of gravity flow of meal from the bins into the cookers or mash tubs, and is considered a more economical arrangement than placing the mills above the bins since the bins are generally situated on the upper floors in any case.

Probably the most modern method of moving the meal from the mills to the bins is the pneumatic system. Bucket elevators have a lower first cost but it is practically impossible to keep such equipment really sanitary. Sanitation is stressed so much in the distillery because the making of whiskey depends upon natural life processes, there being life in the grain, malt and yeast. The more these processes are controlled within definite limits, the better the product will be. The new continuous rubber tube system (Johns conveyor) might serve in this application but it too might introduce sanitation problems.

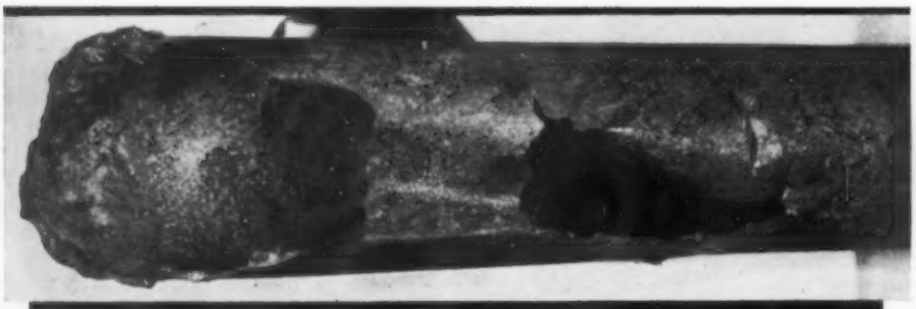
The grain meal bins were made of wood in the old distilleries, because of the physical limitations on the use of other materials. This was before the day of oxy-acetylene and arc-welding on a commercial basis and before the old distillers knew that the rough-jointed surfaces of riveted steel bins would create sanitary problems. Then, too, steel would cause condensation inside the meal bins with deterioration and rotting of grain. However, this objection can be avoided by proper heating and ventilating conditions in the bin room or by suitable insulation. High-grade concrete bins smooth-trowelled on the inside, made impervious by water-proofing treatment and glazed with several coats of Bakelite varnish on the inside, provide the ideal type of bin.

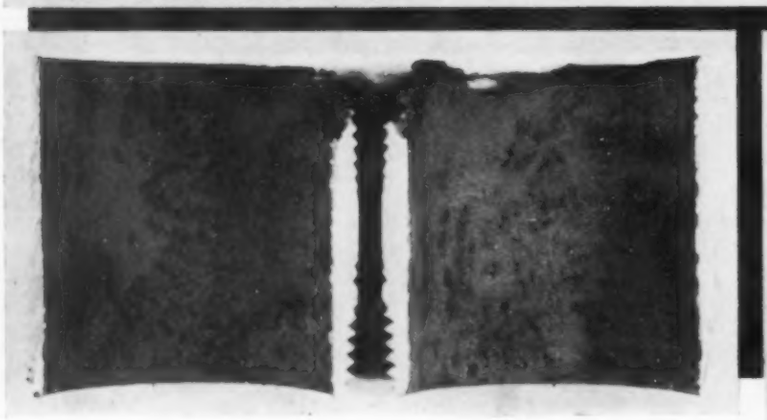
There is need in the distilling industry for standard stock bin manhole-openings that can be fabricated into any type of meal or whole-grain storage bins desired. These manhole entrances should be large enough not only to permit access by workers but also ladders and cleaning equipment. Such opening devices should be fitted with a quick-opening and closing arrangement, and one that while it is dust and air-tight, does not have elaborate gasketting which will collect fine particles of grain flour and cause sanitary difficulties. Because of explosive hazards, there should be no contact between ferrous metals. There is also need for stock items in screw conveyors of construction similar to the above in order to eliminate leakage of dust and points where infection might occur.

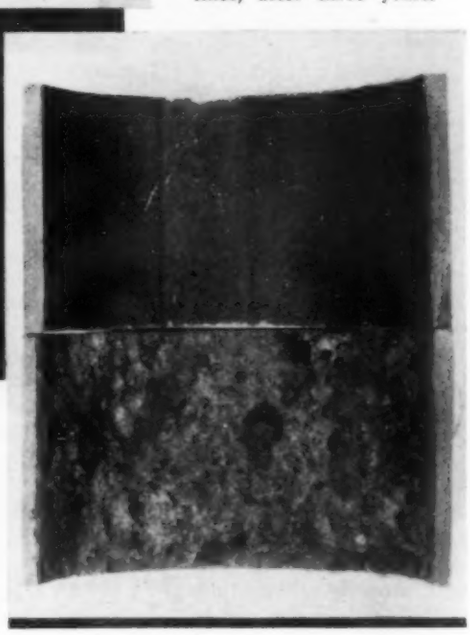
Simple Device to Clean Bins

Both the whole-grain bins and the meal bins must be cleaned thoroughly and frequently, in order to avoid rotting of grain and growth of mold. For this purpose a simple trolley arrangement which would permit a man to ride around the vertical surfaces of the interior of the bin and at the same time raise and lower himself, would be of great help. Proper vacuum cleaning equipment would be useful in connection with the trolley system. The surfaces of these bins are cleaned by a combination brushing and vacuum cleaning tool. The discharge ends of the meal bins should be provided with a suitable type of dust-tight gate valve, one which can be disassembled easily and quickly for the numerous cleanings it will receive. The same type of gate valve also can be used in connection with the screw conveyors for meal.

The grain meal is moved by a combination of screw conveyors and gravity, to either mash tubs or pressure cookers, where all the starches are put into solution by cooking with water. The open type mash tub is rapidly being superceded by the pressure cooker. This is because the latter, a closed vessel, can be easily sterilized. However, it presents some problems not present in the mash tubs. Some operating difficulties of the pressure cookers have yet to be solved in order to eliminate expensive maintenance. These cookers operate by the introduction of steam directly into the mash through the bottom of the mass of grain meal and water. Various types of check valves and rosettes have been tried, but there is always plugging of one or more of the numerous branches







Left—Steel pipe forming part of agitator in beer well holding fermented mash, after three years. Lower left—Pitted condition of wrought iron pipe carrying cooling water. Water is hard. The pH was regulated by addition of sulphuric acid. Below—Steel pipe used for hot water lines, after three years.

of steam lines introducing the steam, with a consequent lengthening of required cooking time. This is a problem which will be solved eventually by distillery engineers, valve manufacturers or both by working together. The poppet valve seems to hold some promise for this application if properly developed.

Materials of construction are a problem in cookers. During the cooking operation carbon-dioxide is present in the vapors above the liquid level of the grain and water mixture. The walls of the cookers are subjected to air, steam, water and carbon-dioxide. The last, at the normal operating pressures in the cookers, is in the form of carbonic acid. Further, the agitators in the cookers are continually rotating during the cooking operation. While various metals for pressure cookers have been tried none has proved entirely satisfactory due to high cost and inherent properties. Steel is the most common material, followed by copper steel, nickel steel and stainless steel. Mash tubs have been made of wood, steel and copper. Recently, some tubs have been made of stainless-clad steel.

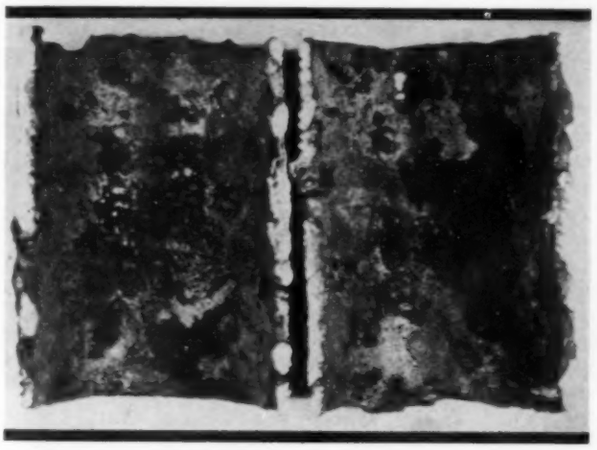
When introducing meal into pressure cookers, large size plug cocks are necessary. They must be constructed free of crevices where material might decay, easily operated and make a tight seal in order to withstand both pressure and vacuum. During the early part of the cooking cycle, steam is introduced with all vessel openings closed, until a pressure of 60 to 70 lb. per sq. in. is attained. After the cooking has been completed the pressure is relieved and the steam allowed to exhaust, either directly into the atmosphere or through a heat exchanger. To lower the temperature further, a vacuum is created in the cooker with a vacuum pump or a barometric jet condenser—the latter is in use in the newer plants. Cast iron jet condensers are satisfactory.

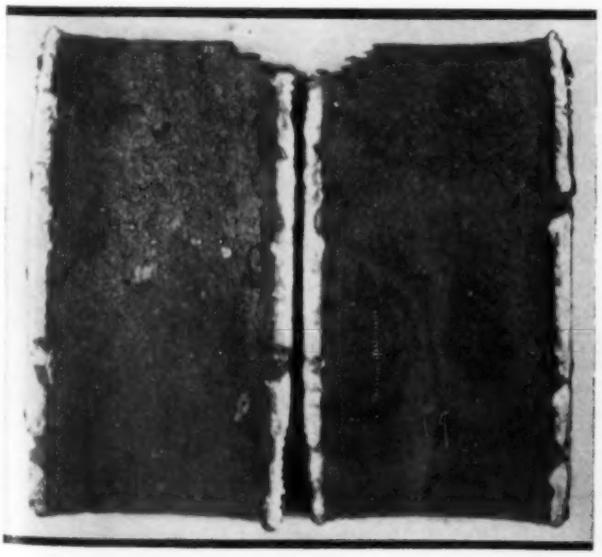
After the mash has been thoroughly cooked and all starches put into solution, the next step is the addition of malted grain meal to convert these starches into fermentable sugars. This is sometimes accomplished by adding a mixture of malted grain and water, previously prepared in a separate vessel, or by the use of what might be termed "mashing machine." By means of this equipment water and malted grain meal may be mixed continuously, introducing the wet mass directly into the cooker or mash tub. Such mashing machines when used are exposed to water, grain and steam, during sterilization periods. Cast iron or steel parts are difficult to keep clean and eventually corrode because of the lactic acid condition which develops. Copper, bronze, aluminum, Inconel or stainless steel parts for this equipment are all satisfactory.

The mash must be cooled to a proper temperature (65 deg. to 80 deg. F.) for filling the fermenters, this temperature being one favorable to the growth of the particular strain of yeast which is then added. Addition of malt and cooling of the mash is accomplished in many different ways depending on equipment used. If a mash tub is used, it is equipped with a coil for heating the mash, steam being introduced into the coils for that purpose. Some distillers turn cold water into these heating coils or into a duplicate set of coils before the malted grain has been added and thoroughly mixed in, in order to bring the mash down to the most favorable malting temperature which ranges from 140 to 145 deg. F. Sometimes these cooling coils in the mash tubs are

used to reduce the temperature further before the mash is emptied into the fermenter. In either instance, the distiller may hold the mash in the mash tub until the conversion process is complete, or may transfer it to another holding vessel called a drop tub or converter which holds the mash until the conversion is complete. When the pressure cooker is used, the malted grain is generally added to the mash after it has been thoroughly pastified and cooled to the proper malting temperature.

The malt is thoroughly mixed into the mash by the cooker's agitator and then the entire mash is transferred to a drop tub or converter to be held until conversion takes place. The drop tubs are subjected to a pH of 4.0 to 4.95 and the per cent of acid as lactic ranges from 0.23 to 0.53 per cent, with the temperature range of 125 to 145 deg. F. While the acid concentration is not high, these converting vessels should be made of low (approximately 0.25 per cent) copper-bearing steel for long life. These converters are, of course, equipped with mechanical agitators to accomplish thorough mixing.





Above—Hot water line to yeast tub after three years of service. Note corroded condition caused by free oxygen and carbon dioxide. Below—From steel pipe used for spray line to boilers, removed from a by-pass between a well water line and recovered 140 deg. water, after three years of service

In either the mash tub or pressure cooker method, the converter or drop tub may or may not be equipped with cooling coils. If it has cooling coils, the mash may be cooled in the converters to the proper temperature for filling the fermenters. If the converters are without cooling coils the mash is pumped through mash cooling devices, generally double-pipe coolers of the counter-flow type, and thence into the fermenters.

Mash coolers are probably the most inefficient equipment around a distillery. Thin film surfaces used in so many efficient heat exchangers cannot be used because of the thickness of the mash. This is a particularly difficult problem with rye mashes, but corn mashes or mashes principally of corn cause some trouble due to their viscosity. Since there exists an acid corrosive condition in the mash and because of sanitary requirements, the inner tube of the double-pipe mash coolers is generally made of hard-drawn copper while the outer pipe is of iron or steel tubing for sake of economy. This tends to set up an electrochemical action between the copper and the steel.

For sanitation reasons, mash coolers are subjected to unusual treatment, they are kept sterile with steam in the inner copper tubes when not in use. Naturally, no cooling water is used between the two tubes at such times. When the cooler is used, the cold water flows through the space between the outer and inner tubes, with hot mash (125 deg.-145 deg. F.) in the inner copper tube. In this case expansion and contraction of the many joints and glands causes considerable difficulty. A gland that would not leak under these severe conditions is most desirable.

The pumps used for forcing the mash through the coolers and into the fermenters are of various types, the constant displacement type being most common. In the duplex steam pump as well as the motor driven duplex pump with variable speed drive, the variable range of speed and therefore variable rate of feed, is sometimes desirable. Such pumps, like the rest of the equipment, must be easily sterilized. Sometimes two positive displacement pumps are built in tandem and used for mash cooling, one plunger pumping the cooling water through the coil and the other one pumping the mash. In other cases, the normal operating pressure of the water supply line is used to pump the water through the cooler. All parts of mash pumps coming in contact with the mash should be made of bronze, copper or stainless steel.

In the preceding description of the processes for preparing grain for fermentation, no mention was made of instruments. Instruments are becoming more and more essential to proper mashing operations and while the old-time distiller had nothing available except a thermometer, the modern distiller has excellent control and recording instruments of which he is making more and more use. Automatic recording and electrically operated scales have replaced old-time hoppers and hand operated weigh beams for weighing meal going to the mash tubs or cookers. Either manually operated or automatically operated flow meters accurately measure volumes of water going to the cookers. Recording thermometers register temperatures throughout the cooking cycle while visual or recording liquid level gages, auxiliary thermometers, electrically operated valves and other modern aids, leave the operators free to concentrate on the other parts of their job.

The mash is pumped from the coolers into fermenters.

Years ago, wooden fermenters were found to be far from ideal but because of low cost and other reasons, practically all distilleries used this type. Most distilleries are replacing wood with metal fermenters. The acidity present in fermenters causes more or less corrosion. Lactic acid concentrations up to 1.8 per cent, carbon dioxide, and sometimes high temperatures are involved. Iron or steel fermenters seldom last more than ten years. The more modern installations are made from copper bearing steel (approximately 0.2 to 0.25 per cent copper), with welded butt joints ground smooth. Copper or stainless steel would be satisfactory but the cost is too great. It is possible that stainless-clad steel is used for this purpose but I do not know of any such installations.

Since truly modern fermenters have attemperating coils, generally made of copper, hung on steel or brass rods, there is the possibility of electrochemical action. With ordinary plate fermenters this can be quite serious. When copper bearing steel is used, the copper tends to hold the oxidized iron on the surface of the steel, thereby tending to produce a film which greatly retards the corrosion rate. Experiments have been made to spray tin on steel fermenters but the cost is excessive for the large surfaces to be covered. Another important point in the construction of metal fermenters is the provision for good drainage so that no material can remain to decompose. Such material courts destruction.

The modern distillery is equipped with closed-top fermenters to insure better fermentation and to permit the recovery of the carbon dioxide gas. The gas is passed through scrubbers in order to remove any entrained alcohol. These scrubbers may be constructed of copper. Iron or steel scrubbers will last only a few years. In one case, a steel shell scrubber with cast iron plates lasted only 39 months.

Machines for developing pure culture yeast should be made of stainless steel or copper. The yeast-growing vessels are generally closed-top vessels equipped with agitators and cooling coils, and the conditions to be encountered are quite similar to the problems to which the fermenters are subjected. This is likewise true of the large vessels which are sometimes called "beer wells" into which the completely fermented mash is conveyed and from which it is later fed to the stills by pumps similar to those used in pumping the mash through the coolers. All such vessels should be made of copper-bearing steel (with a minimum of 0.20 per cent copper, 0.5 per cent is very desirable).

There are various types of stills used for the production of different whiskies but practically every one is made of copper. This metal seems to satisfy the demands for resistance to corrosion, ease of fabrication, and good heat transfer. Some engineers contend that copper acts as a catalyst in the distilling process and that other metals might contaminate the whiskey. Whether these contentions are correct or not, no one has constructed a whiskey still from stainless steel, aluminum, etc. The use of these materials should offer some interesting possibilities.

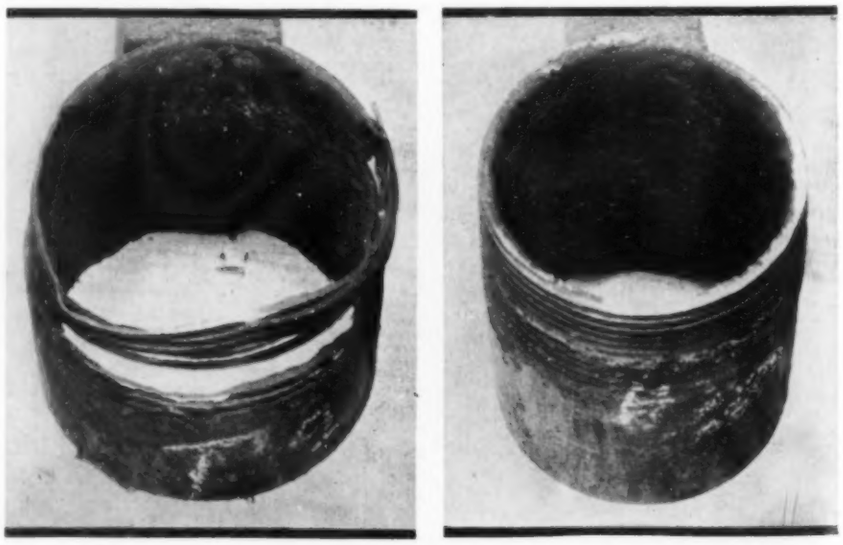
After the distillation process has been completed, the residue, or spent mash, is pumped to the dryer plant for the recovery of the grain solids which are sold as stock feed. Corrosion problems in the dryer plant will be discussed in an early issue of *Chem. & Met.*

In preparing grain mashes in pressure cookers, heat is available for conservation at the time the pressure is relieved. In order to save the heat, a blow-down heat exchanger was installed to heat water for process purposes. It is a bent-tube type. Arsenical copper tubes to date have given no trouble.

Last but not least in the scale of corrosion problems about a distillery is that of return pipe carrying condensate. The problem in general is no different than that encountered in any large central heating plant wherein all steam used for heating purposes is condensed. Naturally the composition of the steam greatly affects the life of such piping systems. Deaeration should be used wherever possible to reduce the free oxygen in all the water entering the system to at least a maximum of one cubic centimeter per liter. After heating the water for any supply purposes, the balance of the free oxygen should be removed if possible by further deaeration. It must be remembered a small amount of carbon dioxide may do considerable damage as it may be driven off as a gas with the steam and redissolve in the condensate forming carbonic acid water which attacks iron. When the condensate is conserved, returned and reheated, this cycle may be carried on indefinitely with a small amount of carbon dioxide doing a considerable amount of damage to all metals coming in contact with the condensate.

Acknowledgement is gratefully made to B. L. Bailie, plant engineer, for maintenance data, to E. R. Luney, chief operating engineer, for operating data and to M. G. Walker, chief control chemist for analyses.

Upper and lower ends respectively of 1-in. black iron pipe handling overflow of reclaimed condensate from whiskey still, after three years of service



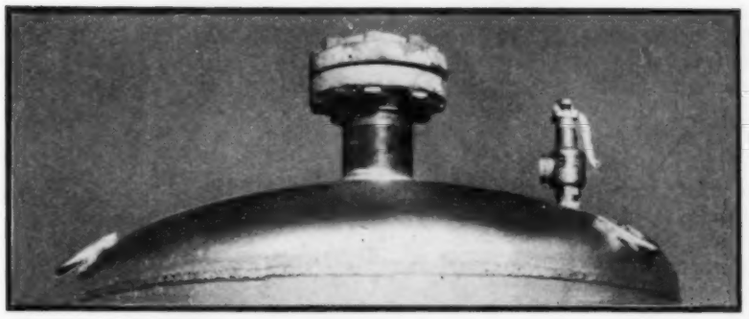


Fig. 1—Safety head used to "back up" a pop valve on an oil and gas separator

"Weak Spots" for Protecting High Pressure Process Industry Equipment

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INTENTIONAL USE of a "weak spot" to protect unfired pressure equipment is not a new idea, but until a few years ago, this safety device usually was applied in a hit-or-miss fashion and little reliance could be placed on it. One large chemical company, it is true, did considerable work on rupture disks for its own use, the results of which were described before the American Institute of Chemical Engineers (see M. E. Bonyun, Frangible Disks as a Protection for Pressure Vessels, *Trans. A.I.Ch.E.*, May 1935; and *Chem. & Met.*, May, 1935, pp. 260–3). Aside from this, however, and the work of the U. S. Bureau of Standards on safety disks for gas cylinders, the literature gives little evidence of investigation of this interesting device. It was not until 1929, after a terrific explosion in an oil and gas separator which resulted in a serious oil well fire, that commercial development of safety disks for all sorts of unfired pressure equipment was undertaken.

As so frequently in explosions of this type, the direct cause was inadequate pressure relief equipment on the separator. Eight to twelve 4-in. safety valves would have been required to relieve the 100 million cu. ft. per day of gas being put into the separator and it appeared that the answer would be a reliable "weak spot" of ample size, built into the separator and designed to fail before the rest of the vessel became dangerously stressed. As manufacturers of oil field equipment, the author's company felt itself obligated to develop such a safety device.

In a period of three years during which the safety device was under development, many types of weak spots were tried before the preformed spheroidal disk in use today was successfully produced. With thin flat metal disks clamped between flanges, bulges would start at very low pressures and the eventual rupture point was found to depend to a considerable extent on the speed of pressure rise. A slow rise of pressure would burst such a disk considerably below its normal rupture point. Furthermore, such disks were unable to withstand fatigue and were consequently abandoned. Shear heads were also studied, but these required extremely accurate machining and in addition were heavy and dangerous when shot into the air. Formed heads were tried, with a weak contour machined thin at their rims, but these were subject to all the ailments of the shear head. Finally, the problem was solved with diaphragms of thin rolled metal of uniform thickness, carefully preformed to spheroidal contours. With this type remarkably uniform bursting pressures were secured, always within 5 per cent of the standard. Hundreds of such diaphragms were burst to prove this necessary consistency of bursting pressure. In addition to their predictability, such diaphragms were found to give complete relief, ripping wide and freeing a full pipe-sized opening, as indicated by the dotted lines in Fig. 4.

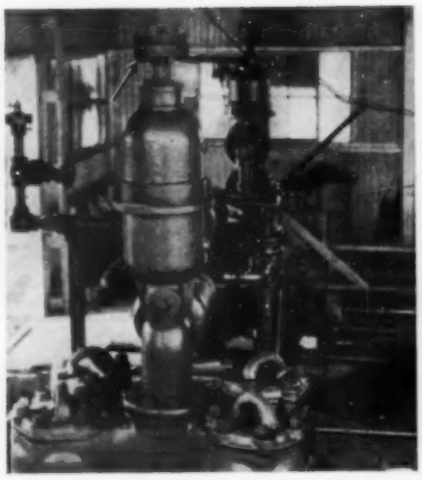
The resistance of these spheroidal disks to fatigue was also found to be decidedly satisfactory. In one demonstration a disk survived 375,700 fatigue pulsations to 70 per cent of its bursting pressure before failure, while the customary performance is as indicated in Fig. 5 which shows the number of pulsations required to produce failure at various percentages of the rated bursting pressure of the disk.

One fact discovered early in the investigation was that ordinary pipe flanges would not suffice for holding a rupture disk. No previously existing type of flange would grip the diaphragm edge with the uniform tightness necessary to prevent creep which would set up unknown stresses and result in a greatly altered rupture point. The type of flange shown in Fig. 4 was developed, relying on the wedge principle to produce remarkable tightness and gripping power without the use of gaskets. To a large extent the success which the safety head has enjoyed may be credited to this design of flange.

Safety heads have many advantages in the protection

Based on a paper presented by the author under the title of, "How an Oil Field Explosion Gave a Reliable Rupture Device to the Processing Industries," before the Process Industries Division of the American Society of Mechanical Engineers, New York, Dec. 7, 1937.

of pressure equipment, not the least of which is their tremendous relieving capacity. The free opening of a ruptured disk permits unretarded flow of gas, liquid or viscous material, whereas the average safety valve opens to only one-eighth of its pipe size area. An interesting comparison of these two relieving devices is afforded by Fig. 6. Furthermore, safety heads have no inertia, responding instantly to pressure and thus being effective against surges too sudden to find ready relief through regular valves. It should be pointed out, however, that no device is capable of venting a detonation. An explosion which is propagated at a rate less than the speed of sound can be relieved by a safety head) or for that matter, by a pop valve if the valve is large and quick enough) but a detonation, traveling at a speed greater than that of sound, cannot be relieved.



Courtesy Eastern Tar Products Corp.

Fig. 2—Safety head on a heavy duty slush pump

Fig. 3, Upper Right—Safety head "backing up" a ball-weight valve on a tar heater

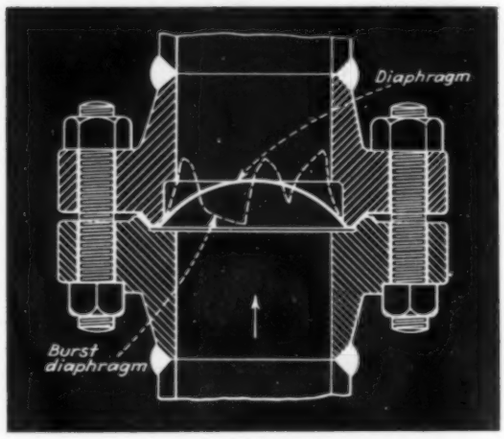


Fig. 4—Cross section of rupture diaphragm and special flanges, showing by dotted lines how diaphragm bursts wide

Almost any rolled metal can be used in the production of spheroidal rupture diaphragms. Copper, aluminum, steel, nickel, Monel metal and stainless steel have been widely used, while silver has been required for a number of operations, notably on vessels containing wet chlorine, and gold has been used on nitric acid vessels. Diaphragms lined or coated with lead, Bakelite and other protective coverings have been used successfully. Thus it has been possible to protect the diaphragm against corrosion almost regardless of the pressure under which it must operate. An interesting point in this connection is that whereas relief valves may be sealed by corrosion so that they cannot open, it does not seem possible that corrosion could strengthen a rupture disk. If not formed of proper corrosion resisting materials, it might become weakened, but never strengthened. Therefore, it seems impossible to raise the pressure of a vessel above the regular bursting pressure of its safety head except by totally blocking off the outlet. Thus the trick of "screwing down" the safety valve, sometimes practiced by operators, is impossible with a vessel protected by a safety head.

Safety heads have been used for the entire pressure range, including vacuum. Sometimes a special vacuum support is required to prevent collapse of the spheroidal diaphragm by vacuum. In other installations it may be necessary to protect against both pressure and vacuum as in the case of a safety head furnished to a large alcohol plant, designed to rupture at 25 lb. pressure or 2 lb. vacuum.

As a matter of course, our safety heads were first installed on oil field vessels of our own manufacture. More recently they have been used to an increasing extent by chemical manufacturers for the protection of autoclaves, pipe lines, kilns, reaction vessels, filters and storage tanks. Paper mills have installed them on digesters, blow tanks and size pumps. In tar and coke byproduct plants they have been used on tar heaters, conditioning tanks and benzol stills. One rubber products plant which had experienced several explosions in its ammonia vulcanizers now uses safety heads to protect these large vessels. Plastics manufacturers have used them on dope filters and resin reaction vessels, while many are being used on vacuum impregnators, compressors, refrigeration systems and on air tanks.

In chemical and various other processing plants, it has become fairly common practice to protect safety valves from the attack of corrosive gases and liquids by installing corrosion resisting rupture diaphragms in the risers ahead of the relief valves. Thus the diaphragm isolates the valve until it is ruptured by excess pressure, whereupon the valve opens to relieve the excess and then closes to allow the vessel to remain in use until a convenient time arrives for renewing the safety head. However, for more complete protection it is often desirable to use a second safety head designed to burst at a somewhat higher pressure, to discharge directly from the vessel to the atmosphere or through an unobstructed vent line to a safe place. The first safety head and the pop valve are proportioned to care for normal conditions while the second safety head is made sufficiently large to vent any volume that might conceivably need relief.

Another common method is to use two safety heads located on risers from a common line. Ahead of each safety head is a stop cock, the two tied together so that when one cock is closed, the other is open. In this way

only one safety head is in service, and when its diaphragm ruptures, the operator may quickly shut off the flow through the burst disk as soon as the emergency has passed and put the second safety head into service. In this manner, pressure relief is obtained and the vessel can continue to operate without a shutdown. The ruptured diaphragm can be replaced without shutting down the vessel.

In many process plants the pressure vessels contain lumpy or semi-solid materials which tend quickly to plug up and render safety valves useless. Such vessels are protected by the arrangement shown in Fig. 7. A large manufacturer of dyes and colors has several such installations on autoclaves. A 2-in. diameter safety head with a 1,200-lb. nickel diaphragm is used in series above a similar diaphragm whose bursting pressure is 1,050 lb. A tee in the line between the two heads carries a 900-lb. safety valve. In service, the lower diaphragm keeps the gummy, corrosive material from the valve, thus preventing corrosion and plugging. After the 1,050-lb. disk bursts, it is intended that the safety valve should open and relieve sufficient material to lower the pressure to 900 lb. and then close again. However, with the heavy materials used in the process, the relief valve soon plugs and this may occur before the pressure has been relieved. In this event the pressure rise will continue until the 1,200-lb. head ruptures.

In using two safety heads in series in this manner, the bursting pressure of the upper one should exceed that of the lower one by at least 10 per cent. It is good practice to replace the upper disk with a new one after it has survived the rupturing of the diaphragm or diaphragms beneath it.

By far the most common procedure is to use a frangible disk to "back up" or supplement a safety valve. A small safety valve set at, or slightly above, the working pressure, is used for operating protection, to take care of mild fluctuations in pressure. This is supplemented by a rupture disk on a separate nozzle, sufficiently strong to prevent fatigue rupture, yet safely below the test pressure of the vessel and of sufficient area to relieve any emergency.

However, on certain types of pressure equipment where the operating pressure is normally uniform and violent fluctuations are the exception, many operators use only the safety head, omitting the pop valve.

A number of other points should be noted in this brief survey. One is that, owing to the tendency of a safety head to weaken at high temperature, its use in relieving explosions due to combustion presents an additional safety factor in that the head combines the protective elements of both the rupture disk and the fusible plug. For cases where this condition is not desired, however, several metals are available which retain their working strength to relatively high temperatures. Sometimes it is desirable to compensate for elevated temperature by using a disk slightly heavier than would be used for the same bursting pressure at atmospheric temperature.

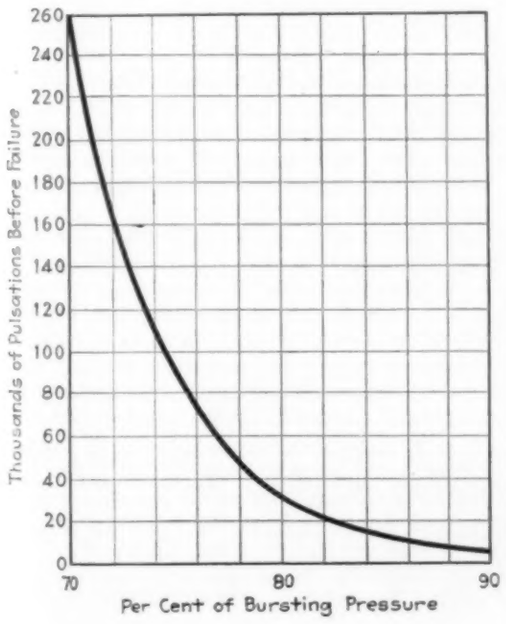
One factor that should not be overlooked in installation is the recoil accompanying the rupture of a frangible diaphragm. When a safety head bursts, a reaction equal to the bursting pressure in pounds per square inch, multiplied by the cross sectional area of the rupture opening, must be absorbed by the equipment and on this account ample foundation must be provided.

After a number of years of experience, we have found very few limitations circumscribing the use of these safety devices with unfired vessels. Although at present a diameter of 16 in. is considered as the maximum practical one for stock sizes, rupture heads as large as 36 in. in diameter have been supplied; and as small as $\frac{1}{8}$ in. diameter for laboratory use. Very low bursting pressures can be achieved only through the use of large diaphragms; but rupture disks are being employed for bursting pressures as high as 15,000 lb. and no upper pressure limit of use has been found.

Fig. 5—Pulsations required to produce failure of rupture diaphragms at various percentages of bursting pressure

Fig. 6, Right—Comparative relieving capacities of safety heads and relief valves

Capacities shown for pop valve No. 1 based on A.S.M.E. Boiler Code (1935), Table U-1; for pop valve No. 2, on highest values reported by a leading safety valve manufacturer; safety head capacities calculated by adiabatic flow equation



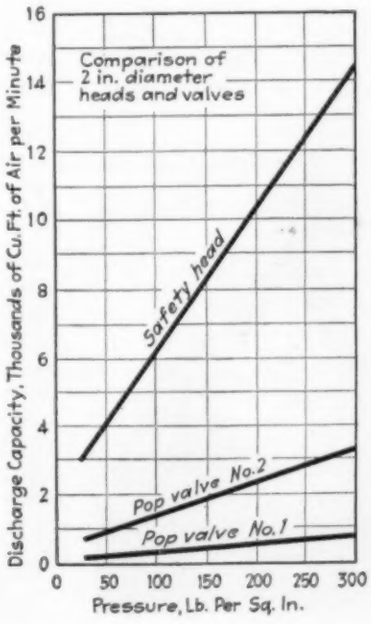


Fig. 7—Dual safety head and pop arrangement used for corrosive or semi-solid materials

Anhydrous Sodium Sulphate From Lake Crystals

By JAMES B. PIERCE, JR.*

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PRODUCTION of anhydrous sodium sulphate by the removal of 10 mols of water from the natural occurring crystal is being, or has been, carried out on a commercial scale by the following methods:

1. Direct heat in a rotary kiln. (Reported to be in use at Fredrichs Lake, Sask.)

2. Direct heat in a rotary kiln with mixing back of a part of the anhydrous sulphate in the feed to prevent sticking and "ringing" of the sulphate in the kiln. (Reported to be in use at Vancouver, B.C.)

3. Utilization of the break in the solubility curve of sodium sulphate at 32.75 deg. C. (91.0 deg. F), where the glauber crystal melts and the solubility of the anhydrous salt decreases with increasing temperature. (See accompanying curve.) When the crystal is melted and heated to 212 deg. F., some 46.0 per cent of the anhydrous sulphate regularly held in the crystal can be precipitated and separated from the liquor in a continuous filtering centrifugal. The 54.0 per cent remaining in the liquor discharged from the centrifugal may be recovered by concentration or crystallization. This process is only applicable to comparatively pure crystals not usually found in natural sources without preliminary purification. (Reported to be in use at Big Springs, Tex.)

4. The three-stage process described below which produced approximately 100,000 tons of anhydrous sulphate in four years of operation (1933-1936), six months per year—24 months' operation in all. (Used at Horseshoe Lake, Sask.)

Mining sodium sulphate decahydrate at Horseshoe Lake, Sask.

Three-Stage Process

Underlying this process is a theory based on two fundamental considerations. First, the principal difficulty in the dehydration of crystal sulphate in a single stage using a direct-fired rotary kiln lies in the "sticking" of the drying sulphate to the kiln. This sticking takes place between the limits of 56.0 per cent and 30.0 per cent of water content. In other words, if a satisfactory preliminary dehydration to 30.0 per cent water content or below, could be devised, the final dehydration to anhydrous sulphate could advantageously be carried out in a direct-fired rotary kiln. The dehydration from 56.0 per cent to 30.0 per cent corresponds to a removal of 66.0 per cent of the water of crystallization in the glauber crystal, and, consequently, requires 66.0 per cent of the heat necessary for the complete dehydration.

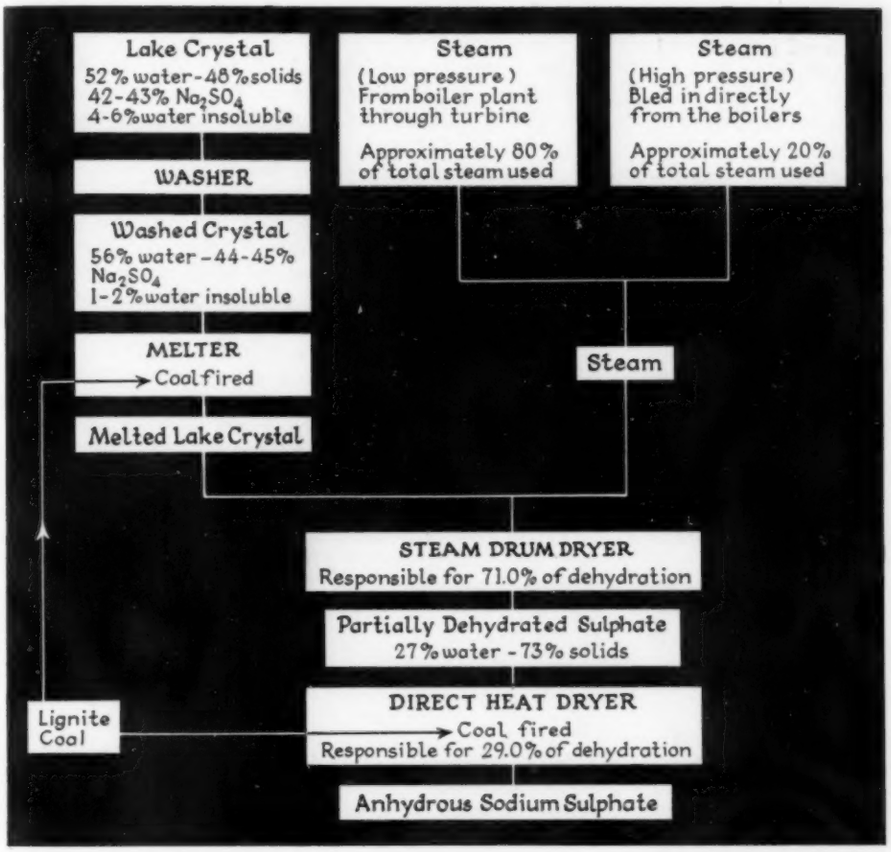
This reduction of the water content in the original crystal can be secured by mixing back sufficient anhydrous sulphate to bring the water content of the feed of a direct-fired rotary kiln down to 30.0 per cent or less, in this way eliminating the principal processing difficulty of a one-step process. However, when this is done other difficulties arise, principally caused by the large amount of anhydrous salt which must be mixed back—approximately weight for weight with the crystal. This keeps a large tonnage of sulphate continuously in circulation which results in high dust losses and dusty, cohesive sulphate instead of the preferred granular, free-flowing anhydrous product.

The second consideration is that, generally speaking, fuel is costly where natural deposits of glauber crystal are located. At Horseshoe Lake† the least costly fuel on a B.t.u. basis is lignite coal, running 6,800 B.t.u. per lb., costing $2.64 per net ton, delivered. There is required to mine and otherwise process the crystal to anhydrous at Horseshoe Lake, 37½ kw.-hr. per ton produced. Any single-stage process shows a lower thermal efficiency

Paper originally presented by the author at the St. Louis meeting of the American Institute of Chemical Engineers, November 18, 1937, under the title "Dehydration of Natural Occurring Sodium Sulphate Crystals at Horseshoe Lake, Sask."

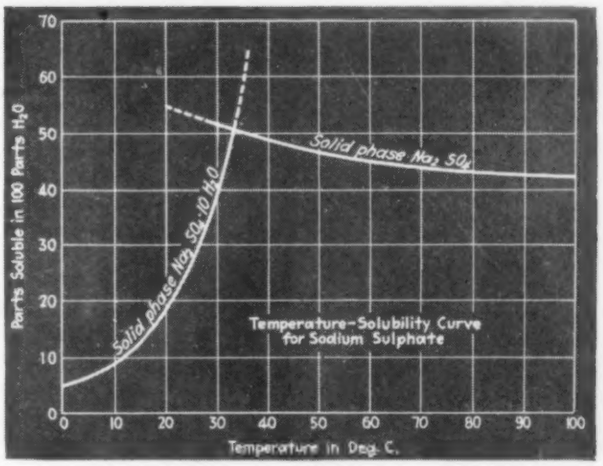
†Formerly owned and operated by Barium Reduction Corp., this plant was purchased in December, 1936, by the International Nickel Co. Consequently, some of the details of operation in use now may differ somewhat from those described herein.—Editor.

*Formerly vice-president of Barium Reduction Corp. and intimately connected with operations in the Horseshoe Lake plant during the years 1933-1936.—Editor.



Left: Simplified flow diagram showing the steps in the production of commercial anhydrous sodium sulphate from lake crystals as carried out at Horseshoe Lake, Sask. Because water is removed first in the melter, second in the steam drum dryer, and third in the direct heat dryer, this method of dehydration is called the "Three-Stage Process."

Below: Temperature-solubility curve for sodium sulphate. Note that the decahydrate gives up its water of crystallization at 32.75 deg. C.



than the three-stage process used at Horseshoe Lake and makes it desirable, if not essential, to use either oil or gas fire. According to the best information available, the fuel cost is approximately 50 per cent greater than that of the three-stage process. The advantage of any process wherein the power requirement could be turbo-generated and low-pressure steam used to carry out the dehydration of the crystal between the limits of 56.0 per cent and 30.0 per cent water content are obvious.

Therefore, the process developed at Horseshoe Lake was based on the desire to avoid the processing difficulties of the direct one-step process, obtain a dust-free, free-flowing product of proper granulation and to secure a power-steam balance resulting in low cost operation. At this lake, located 40 miles south of Moose Jaw, Sask., and about 100 miles north of the United States border in a semi-arid region, the crystal is in solid bed formation, varying in depth from nothing at the shore to 30 ft. in the center. (See Table II for analysis of crystal.)

During the four years considered here (1933-1936), detailed plant operations were carried on as follows: The crystal was first loosened with dynamite and removed with an electric shovel, crushed to 1 in. or less through a roll crusher, and then washed in a log washer to remove the major part of the water insoluble impurities. After this preliminary purification, the washed crystal was melted in two rotary melters 30 ft. long by 4½ ft. in diameter, unlined, stoker-fired with lignite. To raise the temperature of the crystal from 59 deg. F. to 91.0 deg. F. (32.7 deg. C.), melt, and raise the temperature of the melted liquor from 91.0 deg. F., to 129 deg. F., at which temperature it was discharged from the melters, requires theoretically 252,000 B.t.u. per ton of crystal, or 37.0 lb. of 6,800 B.t.u. lignite. Actually an average of 115.0 lb. of lignite per ton of crystal melted was used, which gave an overall thermal efficiency including all combustion and fire-box losses of 32.3 per cent.

Melted liquor, carrying precipitated anhydrous sulphate to the extent of approximately 42 per cent of the original sodium sulphate content of the glauber crystal, was discharged into a sump from which it was pumped to storage tanks equipped with stirrers. From these the liquor was gravity fed to 16 atmospheric drum dryers, 10 ft. long by 4 ft. in diameter (2,000 sq.ft. of surface in all). These dryers used all of the back-pressure steam from the 300 kw. turbine at 8-10 lb. pressure and some additional high-pressure steam bled in directly from the boilers.

Water evaporated on these drums amounted to 0.90 tons per ton of anhydrous sulphate produced (corresponding to a partially dehydrated product containing 73.0 per cent solids and 27.0 per cent water, and to 71.0 per cent of complete dehydration). This evaporation required 3.65 M lb. of 8-10 lb. steam per ton of anhydrous sulphate produced. The temperature of the evaporation was approximately 218 deg. F. Since 2.785 lb. of 8 lb. steam was required to heat the liquor from 129 deg. F. to 218 deg. F. and evaporate, the thermal efficiency of the atmospheric drum dryers was 76.2 per cent. With a boiler efficiency of 59.0 per cent using lignite coal, this resulted in an overall efficiency of 45.0 per cent.

From the atmospheric drum dryers the partially dehydrated sodium sulphate was conveyed by screw conveyors to two direct-fired rotary dryers, 40 ft. long by 6 ft. in diameter. These were unlined except for cast-iron liners for 6 ft. at the fire end, and were fired directly with lignite coal by stokers. Here 0.36 tons of water was removed and 0.15 tons of 6,800 B.t.u. lignite was used per ton of completely dehydrated sulphate, which shows an overall thermal efficiency of 37.0 per cent including all combustion losses. In other words 29.0 per cent of the total water of hydration was removed here. The finished product emerged at a temperature of approximately 248 to 284 deg. F.

General Operating Details

The power plant consisted of two 250 hp. Sterling boilers stoker-fired, which operated at an average of approximately 140 per cent rating, giving an evaporation from and at 212 deg. F. of 4.26, the distillate from the atmospheric drum dryers being returned for boiler feed purposes. Approximately 5 per cent make-up was distilled in a separate still as the water available was not suitable for boiler use. Electric power was generated with a 300 kw. turbo-generator operating at approximately 90 per cent of capacity with a water rate of about 80 lb. per kw.-hr.

Plant operation at approximately 20 per cent out of balance between the low-pressure steam required and that received from the 300 kw. turbine was considered an optimum. That is, approximately 20 per cent high-pressure steam was bled into the low-presure line. Since any waste of low-pressure steam would increase the cost rapidly, this was probably about as close as advisable to carry the balance unless a portion of the melting could be done with the excess low-pressure steam.

Daily production in the Horseshoe Lake plant during the four years averaged 175 tons. A complete analysis of the costs of the various parts of the process may be found in Table I.

Table I—Cost sheet for 100,000 tons of anhydrous sodium sulphate produced over a period of four years at Horseshoe Lake, Sask. Figures are given in dollars per short ton of granular anhydrous sodium sulphate produced

Mining		
[1] Electricity	$0.090	
Explosives	0.166	
Supplies	0.006	
[1] Operating labor	0.190	
Prime cost		0.452
Repair materials	0.139	
Repair labor	0.044	
Repair & renewal cost	0.183	
Total mining cost		0.635
Washing		
Electricity	0.022	
Supplies	0.006	
Operating labor	0.064	
Prime cost		0.092
Repair materials	0.137	
Repair labor	0.015	
Repair & renewal cost	0.152	
Total washing cost		0.244
Melting		
Electricity	0.022	
Supplies	0.006	
[2] Coal	0.345	
Operating labor	0.128	
Prime cost		0.501
Repair materials	0.066	
Repair labor	0.030	
Repair & renewal cost	0.096	
Total melting cost		0.597
Drum Dryers		
Electricity	0.045	
[4] Low-pressure steam	1.179	
Supplies	0.011	
Operating labor	0.261	
Prime cost		1.496
Repair materials	0.157	
Repair labor	0.060	
Repair & renewal cost	0.217	
Total cost of drum dryers		1.713
Direct Heat Dryers		
Electricity	$0.022	
Coal	0.400	
Supplies	0.010	
Operating labor	0.074	
Prime cost		0.506
Repairs materials	0.062	
Repair labor	0.017	
Repair & renewal cost	0.079	
Direct heat dryer cost		0.585
Yard and General		
Electricity	0.022	
Supplies	0.077	
Operating labor	0.168	
Prime cost		0.267
Repair materials	0.215	
Repair labor	0.022	
Repair & renewal cost	0.237	
Total yard & general cost		0.504
Office and Overhead		
Supt's salary	0.101	
Clerk's wages	0.026	
Supplies	0.031	
Compensation Insurance	0.074	
Supt's expense	0.018	
Rental	0.008	
Auditing	0.004	
Legal expense	0.006	
Traveling expense	0.046	
Total office & overhead cost		0.314
Royalty		0.125
Starting & close-down expense[5] (Including taxes and insurance)		0.588
Total Manufacturing Cost		**$5.305**

[1] Average hourly wage rate, approximately 40 cents.
[2] 6,800 B.t.u. lignite delivered @ $2.644 per net ton. Including all charges 0.69 tons of 6,800 B.t.u. lignite was used per ton of anhydrous sulphate produced.
[3] Average cost of electricity per kw.-hr. 0.006
[4] Average cost of high-pressure steam per M lb. $0.370
Average cost of low-pressure steam per M lb. 0.323
[5] As the plant did not operate in the winter (six months per year average operation), the item of starting and close-down expense enters the cost.

Table II—Reported analyses of the sodium sulphate crystals at various points in the three-stage process

Constituent	Per Cent
Average Analysis of Lake Crystals	
Water insoluble (dried)	4.15
Moisture	55.98
Sodium carbonate	0.07
Sodium bicarbonate	0.34
Calcium sulphate	0.12
Magnesium sulphate	0.21
Sodium chloride	0.40
Sodium sulphate	39.05
TOTAL	100.32
Average Analysis of Washed Crystals	
Water insoluble (dried)	1.83
Moisture	56.19
Sodium carbonate	0.17
Sodium bicarbonate	0.25
Calcium sulphate	0.17
Magnesium sulphate	0.21
Sodium chloride	0.07
Sodium sulphate	41.47
TOTAL	100.36
Average Analysis of Anhydrous Sulphate	
Water insoluble (dried)	3.44
Moisture	0.09
Sodium carbonate	0.15
Sodium bicarbonate	0.30
Calcium sulphate	0.62
Magnesium sulphate	0.20
Sodium chloride	0.20
Sodium sulphate	95.04
TOTAL	100.04
Average Analysis of Water Insoluble	
Calcium sulphate	0.90
Calcium carbonate	27.50
Magnesium carbonate	33.50
Fe_2O_3—Al_2O_3	5.50
Silica	32.50
TOTAL	99.90

Characteristics of STRONG PHOSPHORIC ACIDS

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THE HISTORY of the commercial production of phosphoric acids reveals continued effort to secure acids of greater phosphorus pentoxide content. Prior to 1920, practically all phosphoric acid was made by the wet process. This process consists in the treatment of calcium phosphates in the form of phosphate rock or bones with sulphuric acid and the separation of the resulting calcium sulphate from the phosphoric acid by settling and filtration. By this method, only a weak phosphoric acid can be obtained.

Recently the technique of separation of calcium sulphate has been improved with the result that a phosphoric acid containing 30–32 per cent of phosphorus pentoxide is now obtained directly at Trail, Canada ([17]). Before shipping acid of this strength long distances or before using it in the production of most phosphates, concentration by heat is generally required.

A highly concentrated phosphoric acid was first produced commercially in 1920 by the electric furnace method; this process gives directly without requiring further concentration 75 to 95 per cent orthophosphoric acid ([13]). Since 1929, the same product has been obtained directly from phosphate rock in a blast furnace ([8]).

Technical orthophosphoric acid is marketed as 50 and 75 per cent solutions. For industrial purposes, its phosphorus pentoxide content only is of value. Hence, for every ton of phosphorus pentoxide in the form of technical orthophosphoric acid, freight on either 1.76 tons or 0.84 tons of water must be paid.

Very pure orthophosphoric acid of 85 per cent strength is being produced on a small scale by the combustion of phosphorus and the solution of the resulting phosphorus pentoxide in water, or by the concentration of purified weaker acid solutions.

Based on a paper, Chemical and Physical Properties of Strong Phosphoric Acids, presented before the American Institute of Chemical Engineers at St. Louis, Nov. 17, 1937.

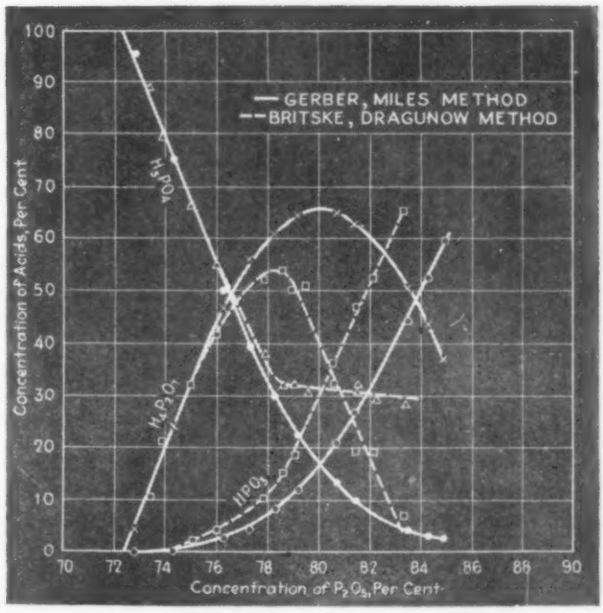


Fig. 1 Composition of strong phosphoric acids

Phosphoric acids of greater phosphorus pentoxide content than that corresponding to orthophosphoric acid have been produced by either dissolving phosphorus pentoxide in less water than is theoretically required for the formation of the ortho– acid, or by dehydrating the latter or its acid salts. Some of the strong or polyphosphoric acids of high phosphorus pentoxide content which have been reported in the literature are listed in Table I.

Many of these concentrated acids have never been positively identified and may merely represent theoretical combinations of phosphorus pentoxide and water. Pyro– and metaphosphoric acids have been available in small quantities, but only orthophosphoric acid has been manufactured commercially. Recently acids of high phosphorus pentoxide content, equivalent to pyrophosphoric and tetraphosphoric acids, have been introduced as commercial products.

Although the physical characteristics of orthophosphoric acid are well known and pyro– and metaphosphoric acids have been partially studied, little has been published on phosphoric acids containing more than 72.4 per cent of phosphorus pentoxide, equivalent to 100 per cent orthophosphoric acid.

The recent commercial production of a phosphoric acid containing up to 84 per cent of phosphorus pentoxide, equivalent to 116 per cent orthophosphoric acid, has indi-

cated the advisability of studying the physical and chemical characteristics of these polyphosphoric acids. It is hoped that the presentation of data on these acids will stimulate study and applications of the phosphoric acids of high phosphorus pentoxide content.

Do the compounds in Table I, which represent the combination of phosphorus pentoxide and water in various molecular ratios, actually exist in strong phosphoric acids of the corresponding phosphorus pentoxide content? On the basis of present information, an unqualified statement cannot be made in answer to this interesting question.

Analytical and physical studies indicate that strong phosphoric acids are mixtures of ortho-, pyro- and metaphosphoric acids, with the possibility that some of the polyphosphoric acids, represented in the table, exist at some concentrations. It has also been found that the relative proportion of these acids appears to be a function only of the relative amount of phosphorus pentoxide and water, and is not dependent upon the method of preparation. Two analytical procedures were applied to this problem in an effort to determine the composition of strong phosphoric acids.

The first analytical procedure was based upon the method reported by Britske and Dragunow (4), and also probably used by Travers and Chu (10), for the determination of pyrophosphoric acid. The following steps are involved: 1. Determination of the total phosphorus pentoxide content of the acid. 2. Titration using methyl orange as the indicator. 3. Continuation of the titration with phenolphthalein as the indicator. 4. Titration of a second aliquot with bromphenol blue as the indicator to first distinct blue color, followed by the addition of 2.5 to 3 times the amount of zinc sulphate necessary to precipitate the pyrophosphoric acid as the neutral zinc pyrophosphate. The liberated sulphuric acid is then titrated.

In Table II are shown the reactions for these titrations. By successive subtractions, the relative amounts of ortho-, pyro- and metaphosphoric acids can be calculated.

The second method was developed recently by Gerber and Miles (10) and involves the following steps: 1. Titration by sodium hydroxide with bromcresol green as the indicator. 2. Continuation of the titration after the addition of silver nitrate solution and methyl red as the indicator. 3. Titration of a second aliquot by sodium hydroxide. Sodium nitrate is added to prevent hydrolysis and the indicator is thymol blue.

In Table II are shown the reactions for these titrations. It is apparent that successive subtractions will give the amounts of the three acids that are present.

The Gerber and Miles procedure involves a further step which adds to the accuracy of the analysis by taking into account the effect of the relative amounts of ortho- and pyrophosphoric acids present on the end points of the bromcresol green and thymol blue titrations. The equivalence point of NaH_2PO_4 is at a pH of 4.6, whereas that of $Na_2H_2P_2O_7$ is pH 4.2; also the equivalence point of Na_2HPO_4 is pH 8.5, whereas that of $Na_4P_2O_7$ is pH 9.1. The end point values for mixtures will lie between the equivalence points of the pure salts.

When the titrations are made, LaMotte pH color satndards are accordingly used in obtaining readings through the pH range 4.2 to 4.6 in the bromcresol green titration and through the range 8.5 to 9.1 in the thymol blue titration. From these readings the exact end points for the particular proportions of ortho- and pyrophosphoric acids that are present can be read from a suitable nomographic chart. The titration volumes corresponding to the exact end points are then used in accurately determining the relative amounts of the three acids.

Both methods of analysis gave results in fair agreement when they were applied to mechanical mixtures of sodium ortho-, pyro-, and metaphosphates or to strong phosphoric acids containing less than 78 per cent phosphorus pentoxide content. Considerable variation in results was obtained, however, when the methods were applied to fused mixtures of pyro- and metaphosphates and to strong phosphoric acids containing more than 78 per cent of phosphorus pentoxide. In Fig. 1 the results from analyses of strong acids by both methods are presented.

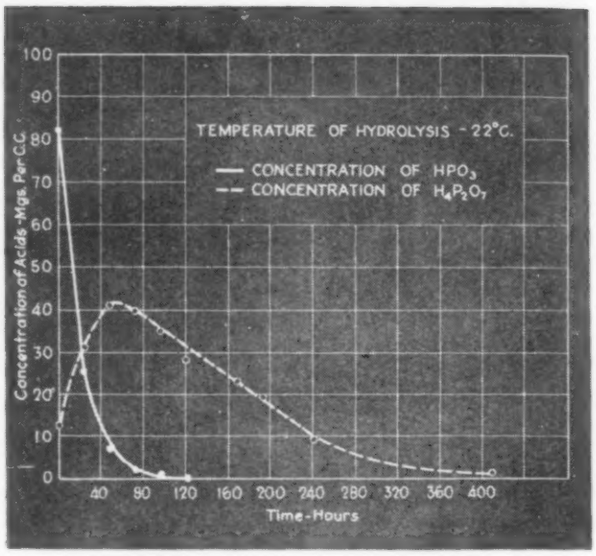


Fig. 2 Hydrolysis of pyro- and metaphosphoric acids to orthophosphoric acid

The increasing divergence of the Britske and Gerber curves for acids containing more than 78 per cent of phosphorus pentoxide presents an interesting problem. Some polyphosphoric acids give no precipitate and others do not liberate sulphuric acid on the addition of zinc sulphate. The Britske method depends upon the precipitation of zinc pyrophosphate for the determination of the amount of pyrophosphoric acid and upon the subtraction of the pyrophosphoric acid from the sum of ortho- and pyrophosphoric acids for the determination of orthophosphoric acid. It is likely, therefore, in the presence of polyphosphoric acids which do not liberate sulphuric acid from zinc sulphate, to give higher values for orthophosphoric acid than are obtained by the Gerber method. The divergence of the Britske and Gerber curves in Fig. 1 is in agreement with this statement and is considered as evidence that polyphosphoric acids may be present in the strong phosphoric acids.

In the titrations of the Gerber procedure polyphosphoric acids are apparently decomposed to equivalent quantities of the simple acids with the result that all of the phosphorus pentoxide content is reported as ortho-, pyro- and metaphosphoric acids. This belief is based upon experimental evidence which indicates that the bromcresol green titration gives a value for the total phosphorus pentoxide that agrees closely with the value determined by the standard procedure with ammonium molybdate, and the sum of the calculated weights of ortho-, pyro- and metaphosphoric acids agrees extremely close with the weight of the sample that has been taken.

Qualitative tests for the presence of ortho-, pyro- and metaphosphoric acids are described in the literature. Application of these tests to the strong phosphoric acids failed to give convincing evidence as to the acids that were present. Although the available analytical methods

Table I—Polyphosphoric Acids

Acid	Formula	Molal Ratio, P_2O_5/H_2O	P_2O_5 Content Per Cent by Weight
Orthophosphoric	H_3PO_4	0.33	72.43
Triterohexaphosphoric	$H_7P_3O_{11}$	0.43	77.16
Pyrophosphoric	$H_4P_2O_7$	0.50	79.76
Penterohexaphosphoric	$H_8P_3O_{10}$	0.60	82.55
Tetraphosphoric	$H_6P_4O_{13}$	0.67	84.01
Hexerohexaphosphoric	$H_8P_6O_{19}$	0.75	85.53
Decaphosphoric	$H_{12}P_{10}O_{31}$	0.83	86.79
Metaphosphoric	HPO_3	1.0	88.74
Octerohexaphosphoric	$H_4P_6O_{17}$	1.5	92.20
Ennerohexaphosphoric	$H_3P_6O_{14}$	3.0	95.94

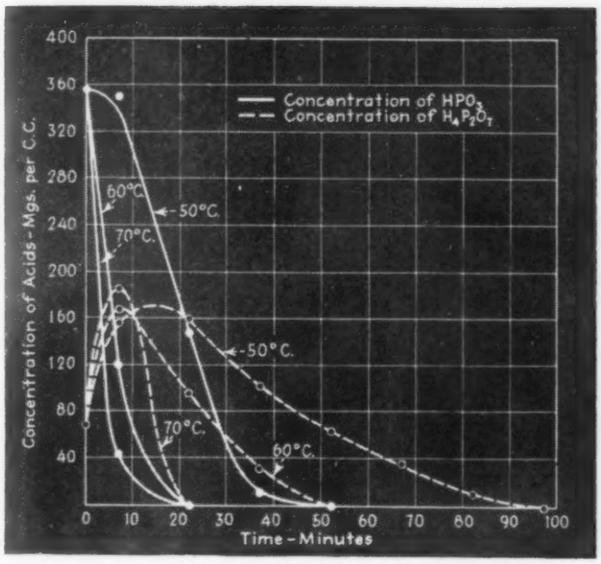


Fig. 3 Extent of hydrolysis of strong phosphoric acids determined by Britske method

did not yield exact information as to the actual compositions of acids in the entire range of phosphorus pentoxide concentrations, the following conclusions may be tentatively advanced:

(a) Strong phosphoric acids consist of equilibrium mixtures of ortho–, pyro–, meta and possibly polyphosphoric acids. Phosphoric acids of the same phosphorus pentoxide concentration were prepared by several methods, including the careful hydration of phosphorus pentoxide, the concentration of weak acids by means of heat and the addition of phosphorus pentoxide to weak acids. After standing for a short time at 100 deg. C., they gave identical analytical values. Furthermore, their composition did not change on standing for long periods, provided that no crystallization took place.

(b) An acid containing 72 per cent of phosphorus pentoxide consists of almost pure orthophosphoric acid. A small amount of pyrophosphoric acid may also be present.

(c) In the range of 72 to 80 per cent phosphorus pentoxide content, the amount of pyrophosphoric acid increases rapidly. Metaphosphoric acid first appears at a concentration of 75 per cent of phosphorus pentoxide.

(d) Crystals of pyrophosphoric acid, when dissolved in ice water and rapidly analyzed, show over 90 per cent of pyrophosphoric acid; when the same crystals are melted, cooled and then dissolved in ice water and rapidly analyzed, the content of pyrophosphoric acid is only from 55 to 60 per cent, the remaining phosphorus pentoxide being divided between ortho- and metaphosphoric acids. From these analytical results, it appears that anhydrous pyrophosphoric acid is partially decomposed when heated above its melting point. The pure crystallized acid can only be changed to the liquid phase without partial decomposition by solution in a medium at a temperature below its melting point.

(e) Although the results of the chemical analyses are reported as ortho–, pyro– and metaphosphoric acid, there is considerable evidence that these acids are not present as such in the strong phosphoric acid, but that much of the pyro– and metaphosphoric acids shown in Fig. 1 is actually present in a combined state in the form of various polyphosphoric acids.

The determination of the exact composition of strong phosphoric acid containing more than 78 per cent of phosphorus pentoxide, presents an immensely interesting problem.

In Table III are compared the solidification characteristics of phosphoric acids of high phosphorus pentoxide content.

Phosphoric acid containing 84 per cent phosphorus pentoxide, equivalent to tetraphosphoric acid, does not crystallize at temperatures as low as minus 50 deg. C. This result is in contrast to a statement by Rakuzin and Arseniev (13), who reported that crystals of tetraphosphoric acid were obtained when the acid was permitted to stand at room temperature for five days.

A description by Rakuzin and Arseniev of the solid phase indicates that the reported crystals were actually pyrophosphoric acid; this lower strength acid might have been formed by the absorption of moisture from the air. Experiments by the authors indicate that crystallization of tetraphosphoric acid cannot be obtained by cooling, seeding or by agitation for extended periods of time.

Although the hydrolysis of phosphoric acids has been studied by previous workers, new data on this subject were secured by the writers. Phosphoric acids of various strengths were dissolved in water under different conditions and their change in composition was observed by use of the analytical procedure of Britske and Dragunow (4).

An acid containing 85 per cent of phosphorus pentoxide was

Table II—Titration Reactions

a. Modified Britske and Dragunow procedure:
Step 1. Total P_2O_5 by the molybdate precipitation method.
Step 2. Methyl orange titration:

$$HPO_3 + NaOH \rightarrow NaPO_3 + H_2O$$
$$H_4P_2O_7 + 2NaOH \rightarrow Na_2H_2P_2O_7 + 2H_2O$$
$$H_3PO_4 + NaOH \rightarrow NaH_2PO_4 + H_2O$$

Step 3. Phenolphthalein titration:

$$Na_2H_2P_2O_7 + 2NaOH \rightarrow Na_4P_2O_7 + 2H_2O$$
$$NaH_2PO_4 + NaOH \rightarrow Na_2HPO_4 + H_2O$$

Step 4. Bromphenol blue titration and zinc sulfate:

$$Na_2H_2P_2O_7 + 2ZnSO_4 + 2NaOH \rightarrow Zn_2P_2O_7 + 2Na_2SO_4 + 2H_2O$$

Step 2 — Step 3 = P_2O_5 as metaphosphoric acid
Step 1 — [(Step 2 — Step 3) + Step 4] = P_2O_5 as orthophosphoric acid
Step 4 = P_2O_5 as pyrophosphoric acid

b. Gerber and Miles procedure:
Step 1. Bromcresol green titration:

$$HPO_3 + NaOH \rightarrow NaPO_3 + H_2O$$
$$H_4P_2O_7 + 2NaOH \rightarrow Na_2H_2P_2O_7 + 2H_2O$$
$$H_3PO_4 + NaOH \rightarrow NaH_2PO_4 + H_2O$$

Step 2. Silver nitrate and methyl red titration:

$$NaPO_3 + AgNO_3 \rightarrow AgPO_3 + NaNO_3$$
$$Na_2H_2P_2O_7 + 4AgNO_3 + 2NaOH \rightarrow Ag_4P_2O_7 + 4NaNO_3 + 2H_2O$$
$$NaH_2PO_4 + 3AgNO_3 + 2NaOH \rightarrow Ag_3PO_4 + 3NaNO_3 + 2H_2O$$

Step 3. Thymol blue titration:

$$HPO_3 + NaOH \rightarrow NaPO_3 + H_2O$$
$$H_4P_2O_7 + 4NaOH \rightarrow Na_4P_2O_7 + 4H_2O$$
$$H_3PO_4 + 2NaOH \rightarrow Na_2HPO_4 + 2H_2O$$

2 (Step 1) — Step 3 = metaphosphoric acid
2 (Step 3 — Step 1) — Step 2 = pyrophosphoric acid
Step 2 — (Step 3 — Step 1) = orthophosphoric acid.

Table III—Solidification of Strong Phosphoric Acids

Acid	P_2O_5 Content, Weight per cent	Solidification Characteristics
Orthophosphoric.....	72.43	May remain liquid at room temperature for a considerable length of time. Solidifies immediately at 0°C or when seeded.
Pyrophosphoric.....	79.76	Solid crystals formed at room temperature on standing or seeding.
Tetraphosphoric.....	84.01	Does not crystallize at low temperatures, even when seeded or agitated.
Metaphosphoric and stronger acids.....	89–94	Glassy solids

dissolved in cold water in the ratio of 17 grams of the acid to 100 grams of water, and was permitted to stand at room temperature, 22 deg. C., for 408 hours. The hydrolysis of the pyro- and metaphosphoric acids to orthophosphoric acid is shown in Fig. 2.

An acid containing 83.74 per cent of phosphorus pentoxide was mixed with sufficient cold water to form a solution equivalent to 75 per cent orthophosphoric acid. During dilution the temperature of the solution was maintained below 30 deg. C. The solution was then split into three aliquots which were placed in water baths at 50 deg., 60 deg. and 70 deg. C. It should be noted that the heat of hydrolysis did not raise the temperature of the acid more than one or two degrees above the temperature of the water bath. The extent of hydrolysis was determined by the Britske method of analysis, and the results are presented in Fig. 3.

Sufficient water was added to a phosphoric acid containing 84 per cent of phosphorus pentoxide to form a liquid containing 54.3 per cent of phosphorus pentoxide, equivalent to 75 per cent orthophosphoric acid, and the mixture was stirred without cooling. In this case the rise in temperature caused the hydrolysis to proceed at such a rapid rate that only orthophosphoric acid was present by the time a sample of the acid could be taken and analyzed.

The summary of the hydrolysis experiments is as follows:

1. Metaphosphoric acid hydrolyzes at a much greater speed than pyrophosphoric acid.

2. Metaphosphoric acid yields some pyrophosphoric acid on hydrolysis according to the analytical results. This is not in agreement with the results of Baraleff (2) and Travers and Chu (10); Fuchs (6), however, reached a similar conclusion.

3. The rate of hydrolysis increases rapidly with increase in temperature. For instance, increasing the temperature of the acid from 50 deg. to 70 deg. C. decreased the time required for hydrolysis from 90 to less than 22 minutes.

4. If acids of 82 to 84 per cent phosphorus pentoxide content, now available in commercial quantities, are diluted with water to approximately 54.3 per cent phosphorus pentoxide content, i.e., 75 per cent orthophosphoric acid, without cooling and under approximately adiabatic conditions, the temperature of the solution will rise to 120–140 deg. C. and the hydrolysis will be completed in less than two minutes.

The densities of the strong phosphoric acids were determined by means of Hubbard pycnometers (1). The pycnometers were calibrated by weighing them empty and filled with distilled water free from air at 36.1 deg. C.; their capacities at 51.5 deg. C. were calculated using 0.26×10^{-4} for the value of the coefficient of cubical expansion of glass. They were then dried and filled with phosphoric acid. To expell the air from the more viscous acids the pycnometers were heated to 125 deg. C. under a vacuum of about 700 mm. Hg. Since this treatment might have caused some change in concentration, the phosphorus pentoxide contents of the heated acids were redetermined. The pycnometers filled with phosphoric acid were then placed in the water bath at 36.1 deg. C. and treated in the same manner as when they were filled with distilled water, except that they were left in the bath for one hour.

After the determination at 36.1 deg. C. had been completed, the thermostat was set to 51.5 deg. C. and the density determinations were repeated in the same manner. All weighings were corrected to vacuum. From the coefficients of expansion for the acids between 36.1 and 51.5 deg. C., the densities of the acids at 20 deg. C. were calculated as listed in Table IV.

Table IV—Densities of Strong Phosphoric Acids

P_2O_5 Weight Per Cent	Density at 36.1°C.	Density at 51.5°C.	Coefficient of Cubical Expansion	Density at 20°C.
72.28	1.848	1.836	0.000423	1.861
79.64	1.981	1.970	0.000361	1.992
83.93	2.046	2.033	0.000415	2.060

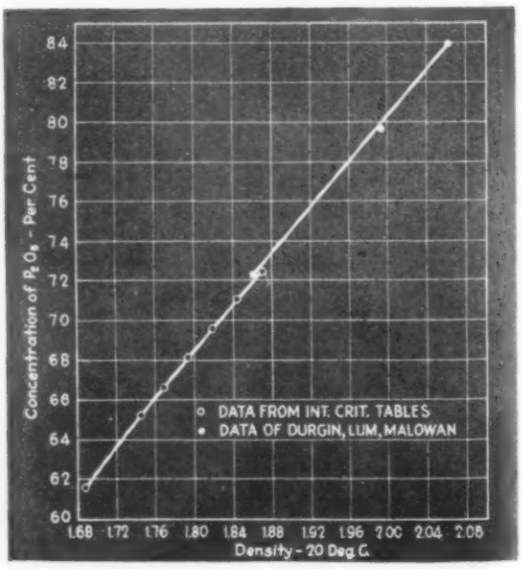
The densities at 20 deg. C. given in Table IV are plotted in Fig. 4. Also, data from the literature (11) are shown. In the only range in which direct comparisons may be made (72.28 to 72.44 per cent phosphorus pentoxide) the experimental density is lower than that given in the literature by 0.006. This difference is of the same magnitude as the accuracy of the experimental method (1). In addition the assumption was made that the coefficients of cubical expansion of the phosphoric acids are constant over the range of 20 to 51.5 deg. C.

Viscosities were determined by the use of a modified Ostwald viscometer (14), which had been calibrated by standard petroleum oils of known viscosity characteristics. In applying this instrument to the measurement of the viscosities of strong phosphoric acids it was believed that surface tension might be a source of error in the viscosity determination (8, 7). Accordingly, the surface tension of an acid with 83.72 per cent of phosphorus pentoxide was measured at 210 deg. F. by the capillary tube method. Calculation of the effect on the liquid head indicated an error of 0.1 per cent; this value is comparable to an estimate of 0.3–0.5 per cent for petroleum oils (6). The relation of viscosity to the temperature and concentration of strong phosphoric acids is shown in Fig. 5.

For a study of corrosion characteristics an acid containing 84 per cent phosphorus pentoxide, equivalent to tetraphosphoric acid, was selected. Since the viscosity at ordinary temperatures is high, it will be necessary in most applications to employ this acid at temperatures considerably higher than room temperature. Accordingly, corrosion tests were made at 60, 120, and 180 deg. C. under conditions of total immersion, with and without aeration of the acid.

The suggestions for the test procedure, outlined by Calcott (5) and Kosting and Heins (13) were followed with few modifications. Test pieces were prepared by grinding with an abrasive wheel and emery cloth to remove oxide film and to expose fresh metal surfaces. They were further cleaned by brushing with soap and water and were dried with alcohol and ether. The testing routine consisted in subjecting the alloys to

Fig. 4 Relation of density and P_2O_5 content of acid



two 48-hour periods at 60 deg. C., one 48-hour period at 120 deg. C., and one 48-hour period at 180 deg. C. After each exposure the solid corrosion products were removed by brushing.

The testing equipment consisted of an oil bath to maintain the temperature of the acid within 0.1 deg. C. of the established value, Pyrex glass test tubes approximately two inches in diameter and 16 inches in length, and equipment for supplying clean, dry air at a rate of ten liters per hour to the aerated acids. Analyses of the acids after corrosion tests indicated that there was no appreciable corrosion of the Pyrex test tubes, as judged by changes in the silica contents of the acids, at temperatures as high as 180 deg. C. Previous work has indicated that traces of impurities in phosphoric acid have important effects upon the corrosion rates of many metals in the acid. The following analytical results apply to the tetraphosphoric acid which was used in the corrosion experiments: P_2O_5——83.5—84.5 per cent, As_2O_5——0.004—0.006 per cent, Fluorine——3.4 ppm., Fe——0.0007—0.0010 per cent, SiO_2——0.03—0.04 per cent, Pb——0.3—0.4 ppm.

Most of the alloys showed excellent resistance to corrosion by tetraphosphoric acid at 60 deg. C.; pure nickel, lead and the lead alloys, and the acid-grade steel, however, were rapidly corroded. Plastics and rubber compositions suffered little change on exposure to the acid at this temperature.

In the range, 120–180 deg. C., the casting alloys such as G–60, Hastelloy C, Illium G and R–55, showed excellent resistance to corrosion. The most resistant alloy in the stainless steel group was the one which was stabilized with molybdenum.

In non-aerated acid one copper alloy, Everdur 1010, showed satisfactory resistance at a temperature as high as 180 deg. C. The high nickel alloys showed similar characteristics. It is interesting to note that Monel formed a strongly adherent coating at 180 deg. C. which effectively decreased the rate of corrosion which was high at 120 deg. C. This observation was made on several sets of Monel samples.

When subjected to corrosion by tetraphosphoric acid at temperatures as high as 240 deg. C., very destructive rates of corrosion were measured with all alloys. At this temperature the Pyrex test tubes were rapidly corroded and the silica content of the strong acid was as high as one per cent after a corrosion test. The presence of this contaminating material probably affected the corrosion rates that were measured at 240 deg. C. In all cases, however, the values were so high that the conclusion was still valid that no metal or alloy was resistant to tetraphosphoric acid at 240 deg. C.

For a few alloys, a direct comparison could be made between the rate of corrosion by aerated tetraphosphoric acid and previously published values for aerated orthophosphoric acid in concentrations of 25.5 and 50.8 per cent (12). Ambrac A, Hy-ten-sl, Monel, Durimet, and Hastelloy C, showed less rapid corrosion with tetraphosphoric acid at 120 deg. C. than with the dilute orthophosphoric acid at temperatures from 80 to 97 deg. C. The chemical and physical properties of the materials evaluated are shown in Table V; a complete summary of the corrosion data is presented in Table VI.

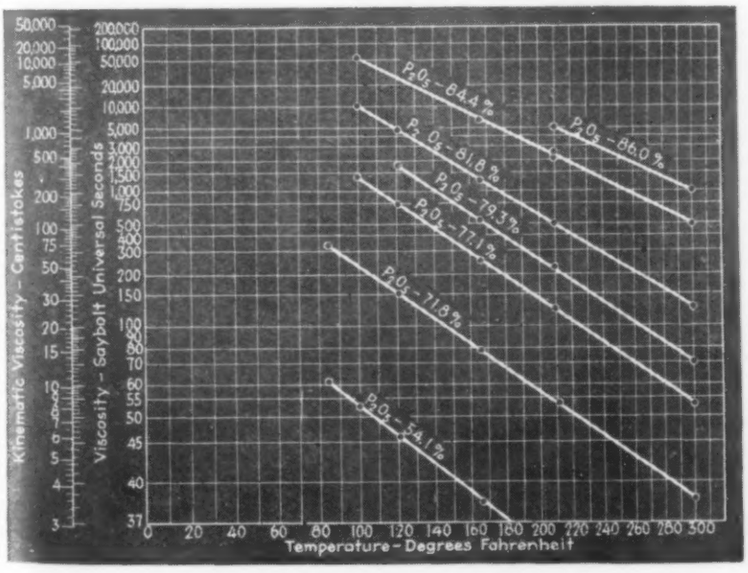
Conclusion

It is hoped that the physical and chemical data which have been presented in this paper, will be helpful to chemical engineers who are studying the application of strong phosphoric acids to industrial processes. As their properties become better known and more thoroughly investigated, it is likely that commercial uses will be developed for this interesting group of compounds.

The rapid rate of hydrolysis at moderately elevated temperatures of the highly concentrated acids, such as tetraphosphoric acid, to orthophosphoric acid is a property that suggests a commercial advantage for these compounds. Each pound of phosphorus pentoxide in the form of tetraphosphoric acid could be shipped with only 0.19 lb. of combined water and could be readily hydrolyzed by the consumer to orthophosphoric acid of the usual strength. By this procedure appreciable savings could be realized over shipment of ordinary 75 per cent orthophosphoric acid which carries 0.84 lb. of water with each pound of phosphorus pentoxide.

The writers wish to acknowledge the assistance of E. C. Dybdal, R. N. Foster and R. L. Schaefer who carried out much of the experimental work presented in this paper.

Fig. 5 Relation of viscosity and temperature of strong phosphoric acids



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Materials of Construction For Handling Strong Phosphoric Acid

An investigation has been made to determine which materials, both metallic and non-metallic, would best resist the action of an acid containing 84 per cent phosphorus pentoxide, equivalent to tetraphosphoric acid. Since the viscosity at ordinary temperature is high, it will be necessary in most applications to employ this acid at temperatures considerably higher than room temperature. Accordingly, corrosion tests were made at 60, 120 and 180 deg. C. under conditions of total immersion, with and without aeration of the acid.

Table V—Metallic and Non-Metallic Materials Tested

No.	MATERIAL	Manufacturers	Nominal Chemical Composition, Per Cent	Machining Qualities	Tensile Strength 1000 Lb./ Sq. In.	Method of Fabrication
1	Admiralty	Chase Brass & Copper Co.	Cu, 70; Zn, 29; Sn, 1	Fair	50	Cold rolled
2	Allegheny 33	Allegheny Steel Co.	C, .098; Cr, 12.22 Ni, .261	Good	73–178	Cast and rolled
3	Allegheny 44	Allegheny Steel Co.	C, .10; Cr, 24.75; Ni, 12.59	Fair	96–131	Rolled
4	Allegheny 66	Allegheny Steel Co.	C, .084; Cr, 17.21; Ni, .354	Fair	72–163	Rolled
5	Allegheny 22 Special	Allegheny Steel Co.	C, .060; Cr, 19.27; Ni, 9.28	Fair	90–111	Rolled
6	Allegheny AMo	Allegheny Steel Co.	C, .060; Cr, 18.18; Ni, 10.17; Mo, 3.19	Fair	87	Rolled
7	Ambrac A.	American Brass Co.	Cu, 74.4; Ni, 20.0; Zn, 5.0; Mn, 0.6	Good	50–90	Cast and rolled
8	Ambraloy 928	American Brass Co.	Cu, 92.0; Al, 8.0	.....	50–120	.....
9	Brass (Rich Low)	Bridgeport Brass Co.	Cu. 85.0; Zn, 15.0	Fair	42–75	Cast and rolled
10	Carbon (Impervious)	National Carbon Co.	Carbon, 85	Machined with carboloy or high carbon tools	2.5	.....
11	Copper-Nickel	Chase Brass & Copper Co.	Cu. 75.0; Ni. 20.0; Zn, 5.0	Fair	55	Cold rolled
12	Cyclops 17-B	Universal-Cyclops Steel Co.	Ni, 20; Cr, 8; C, 0.15	Good	81–125	Cast and rolled
13	Duprene 841–993	E. I. du Pont de Nemours & Co.	Neoprene (chloro–2 butadiene 1–3)	.....	.....	.....
14	Duprene 789 D-135	E. I. du Pont de Nemours & Co.	Neoprene (chloro–2 butadiene 1–3)	.....	.....	.....
15	Durco KA2SMo	Duriron Co.	Cr, 18; Ni, 8; Mo, 3; C, .07	Fair	90	Cast
16	Durco KA2S	Duriron Co.	Cr, 18; Ni, 8; C, .07	Fair	85	Cast
17	Durex 75	General Plastics	Phenol-formaldehyde resin	Fair	6–11	Molded
18	Durimet	Duriron Co.	Fe; Ni, 22; Cr, 20; Si, Mo and Cu, 5; C, .07 max.	Fair	70	Cast and rolled
19	Duriron	Duriron Co.	Fe; Si, 14.5; C, 0.8; Mn, 0.35	Grinding	15–20	Cast
20	Duronze II	Bridgeport Brass Co.	Cu, 97.0; Si, 3.0	Tough	70–100	Cast and rolled
21	Elcomet K	La Bour Co.	Fe, 47; Cr, 23; Ni, 22; Cu, 3.5; Si, 1.25; Mn, 0.50; C, 0.12 max.; Mo, 2	Fair	.....	Cast
22	Enduro 18-8 SMo, Type 316	Republic Steel Corp.	Cr, 16–19; Ni, 14 max.; C, 0.10 max. Mo, 2–4	Fair	.....	Rolled
23	Enduro 18-8 S, Type 304	Republic Steel Corp.	Cr, 17–19; Ni, 7–9.5; C, 0.11 max.	Fair	.....	Rolled
24	Everbrite	Am. Manganese Bronze Co.	Cu, 62; Ni, 30; Fe, 6.5; Si, 0.5; Mn, trace	Good	75	Cast
25	Everdur 1010	American Brass Co.	Cu, 96.0; Si, 3.0; Mn, 1.0	Good	50–110	Cast and rolled
26	G-50	La Bour Co.	Ni, 62; Cr, 24; Cu, 5.5; Mo, 4; W, 2; Si, 1; Fe, 1; Mn, 0.20; C, 0.30	Fair	.....	Cast
27	Hastelloy-C	Haynes Stellite Co.	Ni, 58; Mo, 17; Cr, 14; Fe, 6; W, 5	Machinable	55–79	Cast and rolled
28	Hastelloy-D	Haynes Stellite Co.	Ni, 85; Si, 10; Cu, 3; Al, 1.5	Grinding	36–40.5	Cast
29	Haveg 41	Haveg Corp.	Phenol-formaldehyde resin and asbestos	Fair	2–3	Molded in large size equipment
30	Haveg 43	Haveg Corp.	Phenol-formaldehyde resin and graphite	Fair	2–3	Molded in large size equipment
31	Haynes Stellite 1	Haynes Stellite Co.	Co, 50; Cr, 30; W, 15.5	Grinding	40	Welding rod
32	Hy-ten-al	Am. Manganese Bronze Co.	Cu, 63–68; Zn, 23; Fe; Mn; Al	Good	110	Cast and rolled
33	Illium G	Burgess-Parr Co.	Ni, 56–58; Cr, 21–23; Cu, 6–7; Mo, 4–6; W, 1.5–2.5; Mn, 1.25 max.; Si, 0.8 max.; C, 0.3 max.	Fair	60–73	Cast
34	Inconel	International Nickel Co.	Cr, 15.5; Fe, 6; Ni, 79; Mn, 0.75; Si, 0.25; C, 0.08	Satisfactory	80–200	Cast and rolled
35	Lead, Chemical	National Lead Co.	Pb, 99.9; Cu, 0.06	Fair	3	Cast and rolled
36	Lead, Tellurium-antimonial	National Lead Co.	.....	.....	.....	.....
37	Lead, 6% antimonial	National Lead Co.	.....	.....	5	.....
38	Monel	International Nickel Co.	Ni, 67; Cu, 30; Fe, 1.5; Mn, 1.0; Si, 0.1; C, 0.15; S, 0.01	Satisfactory	65–175	Cast and rolled
39	K-Monel	International Nickel Co	Ni, 66; Cu, 29; Al, 3.3; Fe, 0.9; Si, 0.25; Mn, 0.4	Satisfactory in hardness ranges where machining is possible	90–210	Rolled
40	Misco C	Mich. Steel Casting Co.	Fe; Cr, 29; Ni, 9; Mn, 0.60; C, 0.25; Si, 1.25; S, 0.03; P, 0.03	Fair	95	Cast and rolled
41	Nickel, Super	American Brass Co.	Cu, 69.4; Ni, 30.0; Mn, 0.6	Good	45–75	Cast and rolled
42	Nickel, Pure	International Nickel Co.	Ni, 99+	Satisfactory	55–175	Cast and rolled
43	Ni-Resist	International Nickel Co.	Fe, Ni, 12–15; Cu, 5–7; Cr, 1.5–4; C, 2.75–3.1; Mn, 1–1.5; Si, 1.25–2	Good	25–30	Cast
44	R-55	La Bour Co.	Nickel base alloy	Fair	67	Cast
45	Resistal KA2SMo	Crucible Steel Co.	Cr, 16–18; Ni, 14 max.; C, 0.7 max.; Mo, 2–4	Fair	90–100	Rolled
46	Rubber 9215	B. F. Goodrich Co.	Special rubber	.....	.....	.....
47	Rubber 18KX4	B. F. Goodrich Co.	Special rubber	.....	.....	.....
48	Steel, Acid grade	Pressed Steel Tank Co.	.....	Good	.....	Pressed
49	Uniloy 18-8	Universal-Cyclops Steel Co.	Cr, 8; Ni, 18; C, 0.1	Good	105–125	Cast and rolled

The chemical and physical properties of the materials evaluated are shown in Table V; a complete summary of the corrosion data is presented in Table VI. Corrosion values are expressed in terms of penetration in centimeters per day. In some cases a strongly adhering deposit of corrosion product which could not be removed by the regular brushing procedure, gave an increase in weight of the alloy; such increases are indicated by positive signs in front of the corrosion values. In interpreting corrosion values in Table VI, the usual standard may be applied by which a value of 1×10^{-5} cm. per day or less indicates a resistant material and the values between 1×10^{-5} and 10×10^{-5} cm. per day indicate doubtful materials.

TABLE VI—CORROSION IN TETRAPHOSPHORIC ACID

No.	MATERIAL	Acid Temp. Deg. C.	Non-aerated Acid		Aerated Acid	
			Corrosion Rate Cm./day	Appearance of Test Piece	Corrosion Rate Cm./day	Appearance of Test Piece
1	Admiralty	60	0.1×10^{-5}	Tarnish film	1.0×10^{-5}	Black, loose coating
		120	.....	.....	9.8×10^{-5}	Black, loose coating
2	Allegheny 33	60	0.0	Bright	.....	.....
		120	1.9×10^{-5}	Brown, loose coating	.....	.....
		180	350.0×10^{-5}	Black, adherent coating	.....	.....
3	Allegheny 44	60	0.1×10^{-5}	Bright	.....	.....
		180	59.5×10^{-5}	Black, adherent coating	.....	.....
4	Allegheny 66	60	0.1×10^{-5}	Bright	0.0	Bright
		120	0.9×10^{-5}	Bright	0.0	Bright
		180	55.2×10^{-5}	Black, adherent coating	321.0×10^{-5}	Black, loose coating
5	Allegheny 22 Spec.	60	0.0	Bright	0.2×10^{-5}	Bright
		120	0.1×10^{-5}	Bright	1.4×10^{-5}	Bright
		180	72.0×10^{-5}	Black, adherent coating	124.0×10^{-5}	Black, loose coating
6	Allegheny AMo	60	0.0	Bright	0.0	Bright
		120	0.0	Bright	0.1×10^{-5}	Bright
		180	8.9×10^{-5}	Bright	16.1×10^{-5}	Black, loose coating
7	Ambrac A	60	0.1×10^{-5}	Tarnish film	0.5×10^{-5}	Black, tarnish film
		120	1.1×10^{-5}	Black, loose coating	8.8×10^{-5}	Black, loose coating
		180	15.4×10^{-5}	Gray film	.....	.....
8	Ambraloy 928	60	0.4×10^{-5}	Tarnish film	0.8×10^{-5}	Loose, black coating
		120	0.3×10^{-5}	Black film	6.7×10^{-5}	Black, loose coating
		180	13.5×10^{-5}	Black, loose coating	33.6×10^{-5}	Black, loose coating
9	Brass (Rich Low)	60	0.2×10^{-5}	Slightly etched	0.6×10^{-5}	Black, loose coating
		120	.....	.....	8.6×10^{-5}	Black, loose coating
		180	11.7×10^{-5}	Gray coating	.....	.....
10	Carbon (Impervious)	60	0.4×10^{-5}	Unchanged	.....	.....
11	Copper-Nickel	60	0.1×10^{-5}	Tarnish film	.....	.....
12	Cyclops 17-B	60	0.0	Bright	0.1×10^{-5}	Bright
		120	0.8×10^{-5}	Blue-black film	0.7×10^{-5}	Bright
		180	157.0×10^{-5}	Black, loose coating	180.0×10^{-5}	Black, loose coating
13	Duprene 841–993	60	.....	White, loose coating	.....	.....
14	Duprene 789D–135	60	.....	White, loose coating	.....	.....
15	Durco KA2SMo	60	$+0.2 \times 10^{-5}$	Bright	0.0	Bright
		120	0.0	Thin film	0.4×10^{-5}	Bright
		180	29.5×10^{-5}	Black, loose coating	35.6×10^{-5}	Black partly adherent coating,
16	Durco KA2S	60	0.0	Bright	.....	.....
		120	0.1×10^{-5}	Thin film	.....	.....
		180	24.6×10^{-5}	Black, loose coating	.....	.....
17	Durez 75	60	.....	Unchanged	.....	.....
18	Durimet	60	$+0.1 \times 10^{-5}$	Bright	0.0	Bright
		120	0.1×10^{-5}	Thin film	0.0	Bright
		180	9.5×10^{-5}	Bright	20.0×10^{-5}	Black, loose coating
19	Duriron	60	$+0.3 \times 10^{-5}$	Bright	0.1×10^{-5}	Bright
		120	41.8×10^{-5}	Black, loose coating	40.8×10^{-5}	Black, partly adherent coating
		180	33.6×10^{-5}	Black, adherent coating	380.0×10^{-5}	Black, loose coating
20	Duronze II	60	0.3×10^{-5}	Etched	0.6×10^{-5}	Gray, tarnish film
		120	.....	.....	7.4×10^{-5}	Black, loose coating
		180	11.2×10^{-5}	Gray film	26.9×10^{-5}	Black, loose coating
21	Elcomet K	60	0.9×10^{-5}	Bright	0.4×10^{-5}	Bright
		120	0.1×10^{-5}	Bright	0.0	Bright
		180	12.1×10^{-5}	Black, loose coating	7.0×10^{-5}	Black, partly adherent coating
22	Enduro 18-8 SMo, Type 316	60	.....	.....	0.1×10^{-5}	Bright
		120	.....	.....	0.1×10^{-5}	Bright
		180	.....	.....	21.1×10^{-5}	Gray, loose film
23	Enduro 18-8 S, Type 304	60	.....	.....	0.0	Bright
		120	.....	.....	0.2×10^{-5}	Bright
		180	.....	.....	119.0×10^{-5}	Black, loose coating
24	Everbrite	60	0.5×10^{-5}	Bright	0.5×10^{-5}	Black, loose coating
		120	8.9×10^{-5}	Black, loose film	12.0×10^{-5}	Black, loose coating
		180	51.7×10^{-5}	Black, adherent coating	.....	.....
25	Everdur 1010	60	0.1×10^{-5}	Tarnish film	0.6×10^{-5}	Tarnish film
		120	1.1×10^{-5}	Tarnish film	6.5×10^{-5}	Black, loose coating
		180	4.7×10^{-5}	Gray adherent coating	43.5×10^{-5}	Black, loose coating
26	G-60	60	$+0.1 \times 10^{-5}$	Bright	$+0.1 \times 10^{-5}$	Bright
		120	$+0.6 \times 10^{-5}$	Bright	$+1.0 \times 10^{-5}$	Bright
		180	3.9×10^{-5}	Black, loose coating	13.2×10^{-5}	Black, loose coating
27	Hastelloy C	60	$+0.1 \times 10^{-5}$	Bright	0.0	Bright
		120	$+0.5 \times 10^{-5}$	Bright	$+1.0 \times 10^{-5}$	Bright
		180	0.3×10^{-5}	Gray film	$+0.7 \times 10^{-5}$	Bright
28	Hastelloy D	60	$+0.7 \times 10^{-5}$	Bright	.....	.....
		120	9.1×10^{-5}	Gray, adherent film	.....	.....
29	Haveg 41	60	.....	Unchanged	.....	.....
30	Haveg 43	60	.....	Unchanged	.....	.....
31	Haynes Stellite 1	60	0.0	Bright	.....	.....
		120	0.0	Bright	.....	.....
32	Hy-ten-si	60	1.0×10^{-5}	Bright	0.8×10^{-5}	Black, loose coating
		120	14.1×10^{-5}	Black, loose film	14.7×10^{-5}	Black, loose coating
		180	100.0×10^{-5}	Black, loose coating	.....	.....
33	Illium G	60	$+0.5 \times 10^{-5}$	Bright	.....	.....
		120	$+1.1 \times 10^{-5}$	Bright	.....	.....
		180	8.6×10^{-5}	Black, loose coating	.....	.....
34	Inconel	60	0.1×10^{-5}	.....	0.0	Bright
		120	0.0	Bright	0.2×10^{-5}	Bright
		180	$+0.8 \times 10^{-5}$	Gray, adherent coating	172.0×10^{-5}	Black, partly adherent coating
35	Lead, Chemical	60	69.0×10^{-5}	Pitted	.....	.....
36	Lead, Tellurium-antimonial	60	285.0×10^{-5}	.....	.....	.....
		120	$1,041.0 \times 10^{-5}$	Black, loose coating	.....	.....
37	Lead, 6% antimonial	60	43.0×10^{-5}	.....	.....	.....
38	Monel	60	0.2×10^{-5}	Black, tarnish film	1.0×10^{-5}	Dark film
		120	25.5×10^{-5}	Black, loose coating	25.0×10^{-5}	Black-red, loose coating
		180	$+0.4 \times 10^{-5}$	Brown, adherent coating	61.0×10^{-5}	Black-brown adherent coating
39	K-Monel	60	0.5×10^{-5}	.....	0.6×10^{-5}	Gray, tarnish film
		120	9.7×10^{-5}	Black, loose coating	19.1×10^{-5}	Black, loose coating
		180	2.8×10^{-5}	Black, adherent film	85.3×10^{-5}	Black, adherent coating
40	Misco C	60	.....	.....	$+1.0 \times 10^{-5}$	Bright
		120	.....	.....	$+2.5 \times 10^{-5}$	Bright
		180	67.2×10^{-5}	Black, loose coating	.....	.....
41	Nickel, Super.	60	0.1×10^{-5}	Tarnish film	0.7×10^{-5}	Gray tarnish film
		120	1.4×10^{-5}	Black, loose coating	7.9×10^{-5}	Black, loose coating
		180	18.2×10^{-5}	Gray coating	55.2×10^{-5}	Black loose coating
42	Nickel, Pure	60	9.1×10^{-5}	.....	.....	.....
		120	33.7×10^{-5}	Black, loose coating	.....	.....
43	Ni-Resist	60	1.3×10^{-5}	.....	.....	.....
		120	21.8×10^{-5}	Dull film	.....	.....
		180	11.0×10^{-5}	Black, adherent coating	.....	.....
44	R-55	60	.....	.....	0.0	Bright
		120	.....	.....	$+0.1 \times 10^{-5}$	Bright
		180	.....	.....	1.3×10^{-5}	Black, tarnish film
45	Resistal-KA2SMo	60	.....	.....	0.0	Bright
		120	.....	.....	0.1×10^{-5}	Bright
		180	.....	.....	18.7×10^{-5}	Gray, loose coating
46	Rubber 9215	60	.....	Unchanged except for loose film	.....	.....
47	Rubber 18KX4	60	.....	Unchanged except for loose film	.....	.....
48	Steel, Acid grade	60	11.8×10^{-5}	.....	.....	.....
		120	273.0×10^{-5}	Gray coating	.....	.....
		180	$3,860.0 \times 10^{-5}$	Gray coating	.....	.....
49	Unilloy 18-8	60	.....	.....	0.0	Bright
		120	.....	.....	0.0	Bright
		180	.....	.....	84.0×10^{-5}	Black, loose coating

Notes: { Conversion of corrosion rates: cm./day x 144 inches penetration per year.
{ Plus sign preceding corrosion rate indicates that specimen gained in weight due to the formation of an adherent film.

Past and Present Records of Mills-Packard Sulphuric Acid Chambers

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SULPHURIC ACID is produced, as is well known, by two groups of processes, known respectively as the nitration group and the contact group. In the processes of both groups the reactions involved are exothermic, and the control in all cases consists largely in regulating temperatures in the reaction equipment and in removing the heat of reactions.

In the nitration processes the summation of the reactions entering into the oxidation and hydration of sulphur dioxide for the production of sulphuric acid may be expressed thus:

$$SO_2 + \tfrac{1}{2}O_2 + H_2O \rightarrow H_2SO_4 + 54{,}000 \text{ cal.}$$

The heat units produced by these reactions must be removed to enable the reactions to proceed to completion, to permit continuous manufacture of sulphuric acid in the same apparatus, and to reduce the temperature of the spent gases to a point favorable for the recovery of nitrogen oxides in the Gay-Lussac towers. The more promptly the heat of reactions is removed, the greater the acid-making capacity of a given piece of apparatus per unit of time. The capacity of a given chamber can be increased without increasing the chamber cooling facilities by increasing the concentration of nitrogen oxides in the gas mixture; but in such a case the chamber temperatures become excessive throughout the plant, resulting in excessive costs for lead maintenance, and excessive rates of niter consumption.

The means employed for removing the heat of the reactions in the nitration processes include: (1) Air-cooled lead chambers; (2) Towers irrigated internally with pre-cooled 50-53 deg. Bé. sulphuric acid; (3) Lead chambers sprayed or showered internally with pre-cooled 50-53 deg. Bé. sulphuric acid; and (4) Lead chambers cooled with water applied externally.

The approximate specific heat of 50-53 deg. Bé. sulphuric acid is 0.50, and of air, 0.24, as compared with unity for water. The application of pre-cooled sulphuric acid as a means for removing reaction heat has the advantage that the cooling agent is applied in direct contact with the heated gas mixture, whereas either air or water, when used as cooling means, is applied in indirect contact, a thickness of lead intervening between the cooling agent and the gases to be cooled. In view of these circumstances it is apparent that air is the least efficient of the cooling mediums listed above. Air is, however, the most convenient of the cooling agents named, requiring no apparatus other than the walls and ceilings of the chambers containing the hot gases.

We are concerned here with the fourth of the cooling means cited, namely, the application of cool water externally to lead chambers. Over a long period of years it has been demonstrated that the water cooling not only increases the acid making capacity of a chamber plant per ton of lead used, but also, by keeping the temperature of the chamber lead at a low point, reduces to a minimum the corrosive effect of sulphuric acid on the lead equipment, thus effecting important reductions in maintenance costs and in the rate of depreciation. It has been pointed out (W. G. Mills, *Trans. Inst. Chem. Eng*, **5**, 1927, pp. 48-50) that in the practical operation of the Mills-Packard water-cooled chamber the temperature of the lead of the hottest chamber fluctuates between 65 and 86 deg. F., or but a few degrees higher than the temperature of the cooling water used. The effect of the low temperatures in resisting acid corrosion of the lead is shown by the citation of a three-chamber Mills-Packard plant erected in 1917. Large samples cut from the curtains of these chambers in 1926 were weighed, with the following results:

Original weight of lead, 7 lb. per sq.ft.
Weights after 8 years of service:
No. 1 chamber curtain, 6 lb. 10 oz. per sq.ft.
No. 2 chamber curtain, 6 lb. 6 oz. per sq.ft.
No. 3 chamber curtain, 6 lb. 10 oz. per sq.ft.

An early design of water-cooled Mills-Packard acid chamber was described by the writer in 1921 (*Chem. & Met.*, **24**, May 4, 1921, p. 786). The idea of applying water externally to sulphuric acid chambers for cooling purposes was the outcome of the observation by two Englishmen, W. G. Mills and C. T. Packard, that during a heavy rainstorm in summer time, a box-chamber plant could be operated at greater capacity, or with much less niter consumption, than either before or some time after the downpour. Mills and Packard realized that the vertical sides of a box chamber are not well adapted for the application of water on the outside, and accordingly, in order to facilitate the spread of the cooling water over the lead curtains, they devised a chamber with walls sloping outward from top to bottom, the standard shape finally adopted being that of a truncated cone.

The Mills-Packard conical chamber is not new. The first of these chambers was erected in England in 1914. From this beginning, notwithstanding the interference of the World War, by 1921 a total of 111 Mills-Packard chambers had been erected at 27 different plants, for 22 different companies operating in four different countries.

Paper presented by the author under the title of "Mills-Packard Sulphuric Acid Chambers," at the St. Louis meeting of the American Institute of Chemical Engineers, Nov. 18, 1937.

Table I—Dimensions, Space and Volume Rates of Standard Mills-Packard Chambers

Approximate Volume, Cu.Ft.	Diameters, Top, Ft.	Diameters, Bottom, Ft.	Height, Ft.	Approx. Cooled Surface, Sq. Ft.	Rates per Lb. per Day of Sulphur, Volume, Cu. Ft.	Rates per Lb. per Day of Sulphur, Lead Surface, Sq. Ft.
7,330	10	20	40	1,850	1.75—2.25	0.442—0.568
11,890	11¾	23	47	2,570	2.25—2.75	0.486—0.595
18,750	16¼	28	47¾	3,550	2.75—3.75	0.520—0.712
36,750	28	35	48	5,370	3.75—5.00	0.550—0.730
37,000 (Divided type)	32	35	48	8,700	2.25—3.00	0.530—0.710

Some of these chambers were built as complete Mills-Packard plants, while others were adjuncts to existing box chambers, either for the purpose of expanding capacity or for the replacement of worn-out chambers.

After experience with Mills-Packard chambers had been gained at a number of different plants, it became generally recognized that the space rate of this water-cooled type of chamber was markedly less than that of the box chamber; and, more important still, that the lead surface rate, per pound per day of sulphur burned, was lower. Table I gives dimensions, space rates, lead surface rates and other data relating to several standard sizes of Mills-Packard chambers.

The early design of Mills-Packard chamber comprised a steel-supported structure of sheet lead, from 40 to 50 ft. high (according to the size desired), with a series of five, six or seven leaden gutters encircling each chamber, serving the double purpose of (1) redistributing the cooling water in its descent, at intervals of about 7 ft., and (2) securing the sloping walls of the chamber to a series of rings of steel pipe attached to inclined T-bars.

In the United States installations of the guttered design of Mills-Packard chamber have been made at three of the plants of the Armour Fertilizer Works, namely, at Jacksonville, Fla., at Navassa (near Wilmington), N. C., and at Houston, Tex. The first two installations are complete Mills-Packard plants, while the third is a single Mills-Packard chamber built as an adjunct to a set of box chambers. The Jacksonville plant comprises eight Mills-Packard chambers of the 11,890 cu.ft. size, and the Navassa plant, nine chambers of the 18,750 cu.ft. size. These two plants were built in 1925, and after 12 years of use are still in good physical condition. They are operated at space rates ranging from 2.25 to 2.75 cu.ft. of chamber volume per pound per day of sulphur burned. The operating cost at these two plants, per ton of 60 deg. Bé. acid produced, is believed to be the lowest of any brimstone burning plant of equivalent capacity in the United States.

In 1928 two groups of three Mills-Packard chambers each were added to two rectangular-chamber sulphuric acid systems at the East St. Louis (Ill.) plant of the American Zinc Co. of Illinois. These chambers were erected for the purpose of increasing the production capacity of the plant. Originally, each of the two acid units comprised nine rectangular or box chambers, all of the same width and height, but of various lengths, with an aggregate chamber volume of 345,000 cu.ft. for each acid unit. The Mills-Packard chambers were located near the front of the series of box chambers, but in each system, in order to avoid the condensation of ultra-weak acid in the water-cooled chambers, the latter were not located immediately after the Glover towers but were preceded by one or two of the box chambers. This was

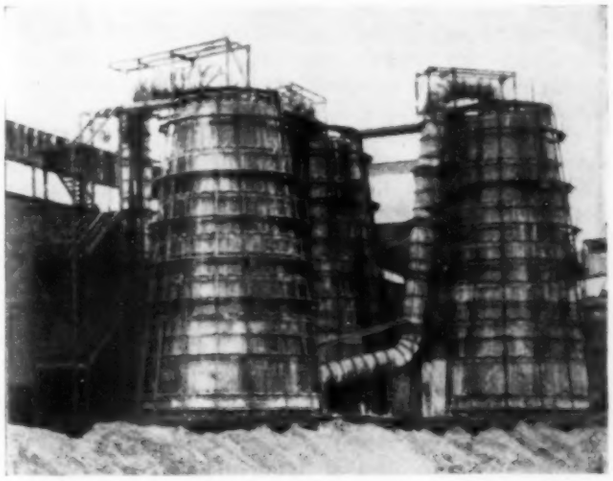
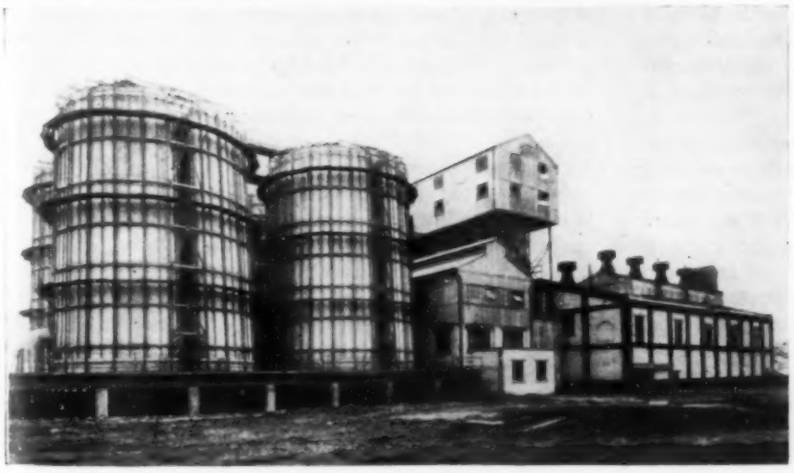
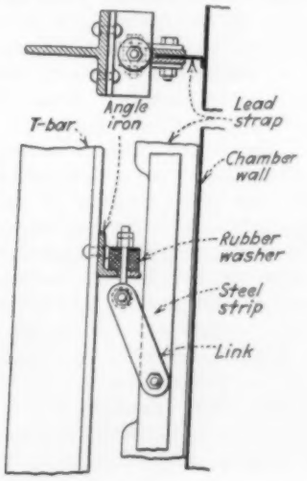


Fig. 1, Left—Group of three Mills-Packard chambers added to a box-chamber plant of American Zinc Co. of Illinois at East St. Louis, Ill.

Fig. 2, Below—Detail of curtain support developed for vertical-strapped Mills-Packard chambers

Fig. 3, Lower Left—Divided Mills-Packard chamber plant of Fison, Packard & Prentice, Ltd., Ipswich, Eng.





because the gases were known to contain an excess of moisture derived from the sulphide ores roasted. The new chambers were of the 18,750 cu.ft. size, and thus a total of 56,250 cu.ft. of Mills-Packard chamber space was added to each acid system, or 112,500 cu.ft. in all.

In addition to the Mills-Packard chambers, the enlargement of this plant comprised a new Glover tower, three rebuilt and enlarged Gay-Lussac towers, enlarged gas flues, and new fans, acid pumps and acid coolers. The installation of the six Mills-Packard chambers increased the aggregate chamber volume by 16.3 per cent, and this small increase in chamber space, together with the other improvements mentioned, sufficed to increase the production capacity of the plant by more than 65 per cent.

Acid measurements have shown that these Mills-Packard chambers produce at the rate of 2.83 cu.ft. of chamber space per pound of sulphur burned per 24 hours, and analyses of the gases entering and leaving these chambers indicate oxidation of SO_2 at a much lower space rate, per pound per day of sulphur burned. A view of one of these two installations is reproduced in Fig. 1, the box chambers being housed in the building just beyond the Mills-Packard chambers.

At the Armour company's plants, and also at the plant of the American Zinc Co., the Mills-Packard chambers erected were of the guttered design originally introduced. In this design, as has been mentioned, each chamber is encircled by a series of leaden troughs or gutters burned to the sides of the chamber about 7 ft. apart. Each chamber thus has from five to seven troughs, depending on the height of the chamber. Each trough carries near the upper edge of its outer wall a ring of small holes, about ½ in. wide and punched at 2-in. centers, and these holes serve to distribute the cooling water in flowing down the chamber sides. The cooling water is supplied to the chamber at the middle of an upstanding lead ring on the top (which is convex outwardly), and this ring distributes the water over the top in all directions. The water is caught in a perforated gutter at the edge of the top, by which it is distributed as a sheet completely covering the chamber curtains, and the sloping walls of the chamber help to overcome the tendency of the cooling water to form small individual streams in its descent.

The horizontal curtain straps adopted in the original design interfered with the even flow of the descending sheet of water, and to secure complete coverage of the chamber curtains with a film of water it was necessary to overcome this interference. This was done by making the horizontal strapping continuous, to form a trough, with outer edge either serrated or perforated with holes as described above. The film of cooling water, interrupted by the trough, is re-formed on passing through the serrations or holes, and then flows as a continuous sheet to the next trough below.

With the replacement of horizontal strapping by upright strapping (first introduced in 1926), the encircling gutters were eliminated, and it was then unnecessary to provide means for redistributing the down-flowing water. The upright method of strapping the chamber curtains was made possible by the development of an improved method for attaching the lead straps to the steel framing. This new design for supporting the chamber curtains (U.S. Patent 1,627,043) is illustrated in Fig. 2. Continuous lead straps extend from bottom to top, parallel to the slope of the chamber walls. A long, narrow strip of sheet steel is bolted to each side of the lead strap. At intervals of about 7 ft. along the length of the strap, these strips of sheet steel and the lead strap are bolted by means of a short steel "link", loosely pivoted at both ends, to an eye bolt that passes through the horizontal flange of a circular angle iron. This last is riveted to a series of T-bars which surround the chamber and constitute its main support. A thick rubber washer surrounding the stem of the eye bolt separates the flange of the angle iron from the adjustable nut at the upper (threaded) end of the eye bolt, thus lending resiliency to the chamber. At the same time the adjustable nut provides a means for adjusting any expansion or contraction in the lead curtain.

Table II—General Data on Five-Chamber Plant of Fison, Packard & Prentice, Ltd.

Number of pyrites burners, 5
Pyrites burned per day, 58.5 long tons
Sulphur in pyrites, 49.0 per cent
Sulphur in cinder, 2.7 per cent
Total chamber space, 185,000 cu. ft.
Total sulphur burned per 24 hours, 61,800 lb.
Chamber space per pound per day of sulphur burned, 3.0 cu. ft.
Acid produced per day (60 deg. Bé. basis), 103 long tons
Niter consumption, on sulphur charged, 3.1 per cent

Burner gases:
- Temperature entering dust precipitator, 580 deg. C.
- Temperature entering Glover tower, 450 deg. C.
- SO_2, 5.8 to 6.3 per cent

Acid leaving Glover tower:
- Temperature, 280 to 290 deg. F.
- Density, 60 deg. Bé.
- Nitrosity, trace to 0.5 oz. $NaNO_3$ per cu. ft.

Acid leaving Gay-Lussac towers:
- No. 1 tower, nitrosity, 40 to 50 oz. $NaNO_3$ per cu. ft.
- No. 2 tower, nitrosity, 12 to 15 oz. $NaNO_3$ per cu. ft.
- No. 3 tower, nitrosity, 5 to 8 oz. $NaNO_3$ per cu. ft.

Exit gases:
- Oxygen, 5 per cent
- Acidity (with water washing tower) 0.6 grains per cu. ft.
- Acidity (without water washing tower) 1.5 grains per cu. ft.

Feed on water washing tower, 60 Brit. gal. per hour

Chamber draft readings:
- 1st parallel chambers, 1.0 to 1.5 mm. +
- Last chamber, 0.5 to 1.0 mm. −

In the original design of Mills-Packard chamber, the slope ratio of the curtains was 1:8 (1 ft. inward for each 8 ft. of height). With the adoption of the link method of curtain support the ratio was changed to 1:10.

Mills-Packard chambers of unusual size were erected at Wednesbury, England, in 1928-9. These chambers had bottom and top diameters of 35 and 28 ft., respectively, and a height of 48 ft. The slope ratio for these chambers was 1:13.7, and the total volume inclosed by each chamber was 36,750 cu.ft. Similar chambers have been built in Czechoslovakia and in Jugoslavia.

The most recent development relating to Mills-Packard chambers is the "divided" chamber. In size this chamber resembles the chambers of the Wednesbury plant, but the slope (ratio 1:32) is much steeper and each chamber is divided into two halves, with an alley about 4 ft. wide between. The sides of the alley separating the two halves of the chambers are lead walls, suitably supported by steel framing. Like the other curtains of the chamber, they are water cooled. The lead walls of the alley may be vertical, but preferably they have an inward slope from bottom to top like the circular part of the curtains. Where the alley walls are sloping, the alley is about 2 or 3 ft. wider at the top than at the bottom. The curtains of this type of chamber are all supported by straps parallel to the slope of the chamber, connected to the structural steel by the link method described above. They are without encircling troughs, yet the coverage of the curtains by the cooling water is entirely satisfactory. The space enclosed by one of these chambers (counting two halves as one chamber) is about 37,000 cu.ft. The top diameter is 32 ft., the bottom diameter, 35 ft., and the

height, 48 ft. The area of lead surface exposed to the cooling water is 8,700 sq.ft., and the ratio of cubic feet of chamber space to square feet of lead surface is 4.25 : 1. The chambers are connected to each other by short gas flues alternately connecting the tops and the bottoms of adjacent chambers. The long downtakes formerly used to connect the top of one chamber to the bottom of the next have been eliminated, and the adoption of the short gas connections, together with the omission of the expensive redistributing troughs, materially reduces the cost of building the chamber, per unit of production capacity.

The divided type of Mills-Packard chamber, which operates at a space rate of from 2.25 to 3.00 cu.ft. per pound per day of sulphur burned (according to the nature of the sulphur material) is illustrated in Fig. 3 which is a view of the plant erected at Ipswich, England, for Fison, Packard & Prentice, Ltd. The plant is of modern construction throughout and employs five of the divided chambers, a total of ten half-chambers.

Patent protection for the divided chamber is afforded by U. S. Patent 1,887,816. Operating data relating to the divided chamber plant erected for Imperial Chemical Industries, Ltd., at Oldbury (near Birmingham), England, have been cited in a previous paper (*Chem. & Met.*, **37**, 1930, pp. 469-70; see also Fairlie, "Sulfuric Acid Manufacture," p. 194, Reinhold Pub. Corp., New York, 1936).

Data presented in Table II, relating to the five-chamber (divided type) pyrites-burning plant illustrated in Fig. 3 have been received recently from England. Of the ten half-chambers in this plant, eight are connected in two parallel rows of four half-chambers each, while the last two half-chambers are connected in series. The half-chambers comprised in the two parallel rows are numbered consecutively from 1 to 4 and 1-A to 4-A, while the two half-chambers connected in series are numbered respectively 5 and 6. The figures given are averages.

From the temperatures of the last chamber given in Table III, (105 to 110 deg. F. in the month of June) it is evident that the chambers were by no means being pushed to their maximum capacity. With intensive operation comparable to American practice when crowding air-cooled box chambers at a rate, say, of 7 cu.ft. per pound per day of sulphur burned, it is apparent that with brimstone gas the divided chamber is easily capable of a space rate of 2.25 cu.ft. or even less, except in the hot months of July and August.

Table III—Chamber Temperatures and Strength of Drips in Plant of Fison, Packard & Prentice, Ltd.

(Time of year, June; atmospheric temperature, 62 deg. F.)

Half-Chamber Numbers	Temperatures, Deg. F.*		Drips,†	Bottom Acid	
	Outside	In Alley	Deg. Bé.	Deg. F.	Deg. Bé.
1	185	190	55	130	53
2	187	190	56	130	54
3	166	166	55	110	54
4	155	150	54	100	53
1-A	195	200	55	130	53
2-A	195	200	56	130	54
3-A	180	180	55	110	54
4-A	164	160	54	100	52
5	135	145	54	80	52
6	110	105	50	70	47

* The "outside" temperatures were taken on the curved side of the half-chamber, and the "alley" temperatures in the passageway between the chamber halves.
† Strength of drips not corrected for temperature.

Table IV—Cooling Water Atomizers in Plant of Fison, Packard & Prentice, Ltd.

Cooling water, 10,000 to 12,000 Brit. gal. per hr., equally divided among 10 half-chambers
Chamber atomizers, 97; average number operating, 90
Water atomized, 400 Brit. gal. per hr.

Half-Chamber Number	Number of Atomizers	Half-Chamber Number	Number of Atomizers
1	8	2-A	10
2	10	3-A	13
3	13	4-A	8
4	8	5	8
1-A	8	6	11

The quantity of cooling water required for Mills-Packard chambers is between 0.25 and 0.30 American gal. per hr. per sq.ft. of cooled surface. The water should be reasonably clean, as muddy water is likely to leave more or less deposit on the lead surfaces. If the water used is subject to the growth of algae, this nuisance can be abated by treatment of the water with small doses of copper sulphate. If there is a tendency for crusts or deposits to form on the chamber sides, these can frequently be removed with ease by adding a bucket of sulphuric acid, once a week or once a month (according to the rapidity of the crust formation) to the water supply at the top of the chamber. But this should not be done if the cooling water is re-circulated. Where the cooling water is re-circulated and re-cooled after use, in a cooling tower or spray pond, the loss of water by evaporation is found to be from 6 to 7 per cent of the total quantity of water used on the chambers.

On equal bases of comparison as regards weight of lead per square foot, character of foundations, supporting platform, chamber framing, etc., Mills-Packard chambers unhoused, can be erected for about 43 per cent of the cost of box chambers of equivalent acid-producing capacity, housed in a wooden building. If the chamber building housing the box chambers is of fire-proof material, the cost comparison is even more favorable to the Mills-Packard chambers, which require no housing. On account of its comparatively low cost of construction, the Mills-Packard chamber is preferable to the box chamber for expanding the production capacity of an existing box chamber plant, as well as for the replacement of worn-out box chambers.

The principal advantages claimed for Mills-Packard chambers, as compared to the box chamber, may be summarized as:

1. Relatively lower construction cost (less than 50 per cent of that of box chambers). No housing required.
2. Relatively lower maintenance cost. By reason of the low temperature of the lead owing to the water cooling, and the protection from the sun afforded by the film of cooling water, the lead depreciation is reduced to a minimum. Elimination of the chamber building avoids building maintenance. There is less than one-half the weight of lead, per unit of acid made, to be maintained.
3. Relatively lower operating cost. The Mills-Packard plant is so compact that a relatively smaller crew is required to operate the plant. Even a 100-ton brimstone plant can be operated with one man per shift. Niter expense is no higher than with box chambers.
4. A saving of over 50 per cent of the ground space required for box chambers of equivalent capacity.
5. Much lower charges for all overhead items based on cost of construction, such as depreciation, taxes and insurance.
6. Complete fire-proof construction.
7. Easy chamber pan renewal. The chamber-pan, which is the most frequently renewed part of a lead chamber, being relatively small, is easily and quickly repaired or renewed, with minimum loss of production while the chamber is out of service.

Mills-Packard plants for the production of 60 deg.

Bé. sulphuric acid and weaker strengths are claimed to be preferable, not only to the box chamber plant but also to the various types of contact plant. The reasons assigned for the preference of the Mills-Packard plant to a contact plant are:

1. Lower construction cost per unit of production capacity. The relatively lower cost is especially marked in the case of plants operating on sulphide-ore gas, but is also realized in the construction of brimstone-gas plants.

2. Lower operating cost per ton of 60 deg. Bé. acid, owing to: (a) Smaller operating force required; (b) Lower wages for less expensive operatives; (c) Lower maintenance on less expensive and more durable plant equipment; (d) 97 to 98 per cent recovery of sulphur burned, as acid made, as compared with from 93 to 95 per cent sulphur recovery at contact plants; (e) Lower annual charges on items based on plant investment, such as depreciation, interest, taxes and insurance; (f) Depreciation about 4 to 5 per cent annually, as against 8 to 10 per cent for a contact plant.

3. In the event of a plant becoming worn out, or of discontinuance of operations, a salvage value of from 40 to 50 per cent of the original weight of the lead installed in the plant is obtainable, as compared with no salvage value for a dismantled vanadium contact plant.

How to Reduce Plating Department Costs

By E. D. CLANCY

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THERE are two means available for correcting low power factor, capacitors and synchronous machines. The choice is usually one of relative economy. Frequently plants using synchronous motors for power drives operate these motors unloaded to obtain increased power factor correction, although often the substitution of capacitors is much more economical. For example, one plant has recently supplemented synchronous motors with capacitors for power factor correction resulting in a substantial saving in kilowatt-hour energy consumption and a lowering of maintenance cost.

In the plant's electrotype department are two motor generator sets for plating purposes, directly coupled to and driven by 60 hp. synchronous motors. Maintenance and repair cost on the synchronous motor fields was running considerably above normal. The abnormal maintenance cost on the motor fields was because:

1. The motor fields had been revamped by shimming out the poles to decrease the air gap.

2. The excitation was being maintained at a 50 per cent higher value than the machines were normally designed for.

3. This revamping resulted in a considerable increase in power factor corrective effect of the motors.

4. Even with the increase in corrective capacity, it was found necessary to run the machines 24 hours a day, seven days a week, in order to produce sufficient leading reactive kva. hours to avoid a power factor penalty.

5. The loaded or productive period for the motor generators was eight hours a day, five days a week.

6. The abnormal increase in excitation (50 per cent) in addition to the continuous 24 hour operation caused rapid deterioration of the fields.

Table I. Operating Hours Per Year

24 hours x 7 days x 52 weeks	=8,736	hours per year.
8 hours x 5 days x 52 weeks	=2,080	productive hour per year (machines run-loaded).
	6,656	non-productive hours per year (machines running unloaded).

Table II. Synchronous Motors Operation

6,656 hours x 70.26 reactive kva.	=467,650	reactive kva. hours per year.
6,656 hours x 16.8 kw.	=111,820	kw.-hr. loss per year.
111,820 kw.-hr. x $.00755	=$844.25	cost of operating two machines unloaded per year.

Table III. Capacitors Operation

8,736 hours x 55 reactive kva.	= 480,480	reactive kva. hours per year.
8,736 hours x .183 kw.	=1,598.69	kw. hours loss per year.
1,598.69 kw.-hr. x $.0095	=$15.19	cost of operating 55 kva. of capacitors per year.

Table IV. Costs of Installation and Savings

Energy cost synchronous motors operation.....	$844.25
Energy cost capacitor operation.....	15.19
Energy cost saving per year.....	$829.06
Approximate saving per month.....	69.00
Investment 55 kva. capacitor.....	$1,221.00

Instrument readings were taken and the losses for operating the two motors unloaded, including excitation, was found to be 16.8 kw. The load kva. was 72.24, the leading reactive kva. 70.26, and the power factor .232. by calculation it was found that 55 kva. of capacitors operating 24 hours a day would produce an equivalent or greater number of leading reactive kva. hours as the synchronous motors were delivering during their idle or non-productive period.

Table I is a schedule of the actual operating hours per year. Test data tabulated in Tables II and III show a direct comparison of operation between the synchronous motors and capacitors. It should be noted that in computing cost of operation, the minimum average rate of $.00755 per kw.-hr. was used for the motors and the maximum average rate of $.0095 per kw.-hr. was used for the capacitors.

Table IV gives a summary of the data showing cost of installation and approximate savings.

Approximate time to pay for investment, not including interest charges is eighteen months.

In addition to the actual tangible savings secured, an intangible saving of no small value was realized. Taking the machines out of operation 16 hours a day increased the life of the motor insulation, the plating generator brushes and the bearings of both motor and generator. Also it eliminated the necessity of any supervision of the machines during these hours.

Some Physical Considerations in the Safe Handling of Flammable Liquids

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IN OUR CURRENT standard references,[1,2] the tabular listings of explosive limits and flashpoints of flammable liquids are both incomplete and somewhat misleading. First, they embody a number of inconsistencies arising from the unlike observation methods of different investigators. And second, since they show no effect of temperature and pressure on explosive limits, there is sometimes a tendency to infer that these factors do not enter into the safe handling of flammable liquids. Actually this far from true in most cases. Where flammable liquids are contained in closed vessels such as tanks, pipes and certain processing equipment in which liquid and vapor tend to approach equilibrium, temperature and pressure are just as important considerations in safe handling as are the explosive limits themselves. In this paper an attempt is made to clarify the situation, to give a more accurate picture of explosive limits and the correlation of flashpoints with the lower limits.

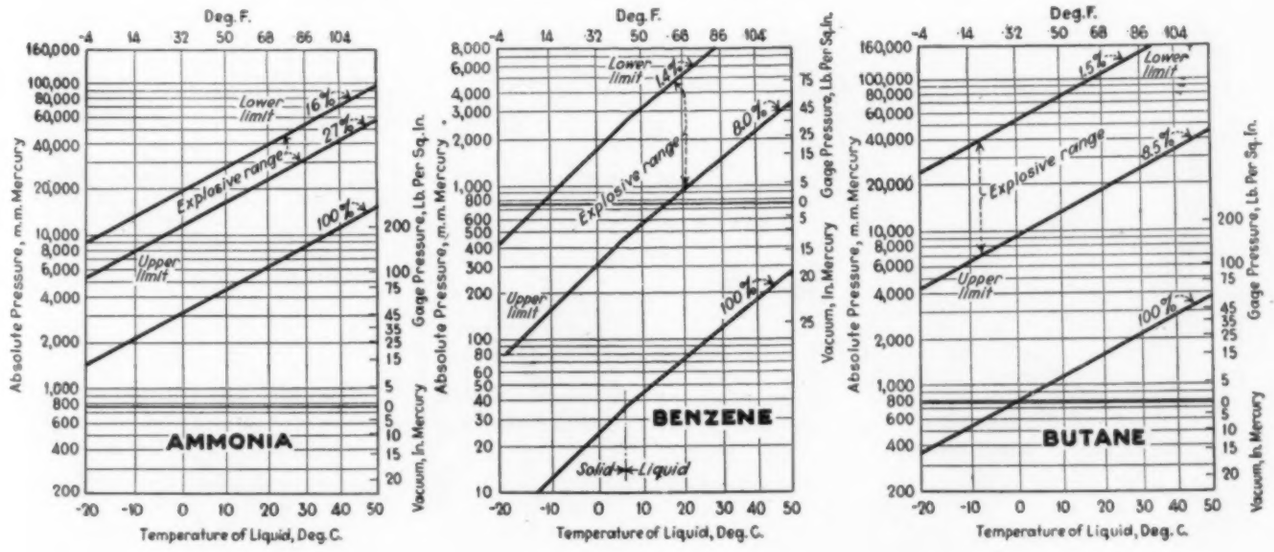
Explosive limits of a flammable liquid are commonly expressed in terms of volumetric percentages of vapor in the vapor-air mixtures at the upper and lower boundaries of the explosive range. For practical purposes it is safe to assume that these limits do not vary with pressure and temperature, although such may not be strictly the case for extreme conditions.[3] But while the limits themselves do not change, the important point is that in a closed system any change in temperature or pressure is accompanied by a corresponding change in composition of the vapor-air mixture over the liquid—and for a flammable liquid that change may move the vapor concentration either into or out of the explosive range. The effect quite evidently is the same as would result from shifting the explosive limits. And so it is for the purpose of showing these effects of temperature and pressure, as well as indicating the explosive range itself, that a graphical presentation of flammability data is offered here.

Presented under the title, "Some Theoretical considerations in the Safe Handling of Flammable Liquids," at the St. Louis meeting of the American Institute of Chemical Engineers, November 18, 1937.

Explanation and Use of Charts

It has been pointed out that explosive limits are expressed in terms of volumetric percentages of vapor in the vapor-air mixtures at the boundaries of the explosive range. Volumetric percentage is equivalent to mol percentage, and this is equivalent to the ratio of partial pressure to total pressure. Consequently, an explosive limit may also be expressed for a given temperature as a ratio of partial pressure of the vapor at the limit to total pressure of the vapor-air mixture. It follows, then, that knowing the explosive limits of a liquid and its vapor pressure at a given temperature, the total pressures at

Fig. 1-3: Pressure-temperature explosive ranges for some common flammable liquids



which the explosive limits are reached at that temperature can be calculated for equilibrium conditions. *Example*: From recorded data butane has explosive limits of 1.5 per cent and 8.5 per cent, and at 0 deg. C. has a vapor pressure of 790 mm. Then at the lower limit $0.015 = \frac{v}{V} = \frac{p}{P} = \frac{790}{P}$, from which the total pressure, P, at 0 deg. C. is calculated to be 790/0.015 or 52,700 mm. By the same process, the total pressure at the upper limit is 790/0.085 or 9,300 mm.

When the total pressures calculated over a range of temperatures from —43 deg. C. to +50 deg. C. are plotted against temperature, two curves result as shown in Fig. 1-6. The region between the curves indicates the explosive range, within which the flammable liquid in question is a fire hazard. Outside of this range the vapor-air mixture is relatively safe, i.e., above the upper line the vapor-air mixture is said to be "too lean" to burn and below the lower line "too rich" to burn.

In these plots the vapor-air mixture is assumed to be in equilibrium with the liquid. On the butane chart, Fig. 3, starting at +10 deg. C. and 30,000 mm. pressure, if the pressure is kept constant and the temperature lowered, more of the vapor will condense until the "too lean" condition is reached at —14 deg. C. Raising the temperature, however, evaporates more liquid until the "too rich" condition is reached at +36 deg. C. Thus for butane there is an explosive temperature range of 50 deg. at 30,000 mm. pressure. If the temperature is kept constant and pressure is varied, the "too lean" condition is approached at 75,000 mm. and the "too rich" condition at 15,000 mm., thus giving an explosive pressure range of 60,000 mm. (1,200 lb. per sq.in.). At —20 deg. C. the pressure range decreases to 20,000 mm. (400 lb. per sq. in.)

Over the temperature range —15 deg. to 30 deg. C. the butane-air mixture in equilibrium with liquid butane would always be in the "too rich" region if the pressure were below 5,000 mm. (85 lb. per sq.in. gage). This means that in any locality where the temperature does not fall below —15 deg. C. liquid butane can be blown from one vessel to another by air at a pressure of less than 85 lb. per sq.in. gage without danger of creating an explosive mixture, providing equilibrium is established or nearly so.

Fig. 7 is a plot of the lower explosive limits of some common flammable liquids and shows at any temperature the value above which the pressure must be maintained in order to stay in the "too lean" region. Fig. 8 is a similar plot of the upper explosive limits of the same liquid and shows at any temperature the value below which pressure must be maintained in order to stay in the "too rich" region.

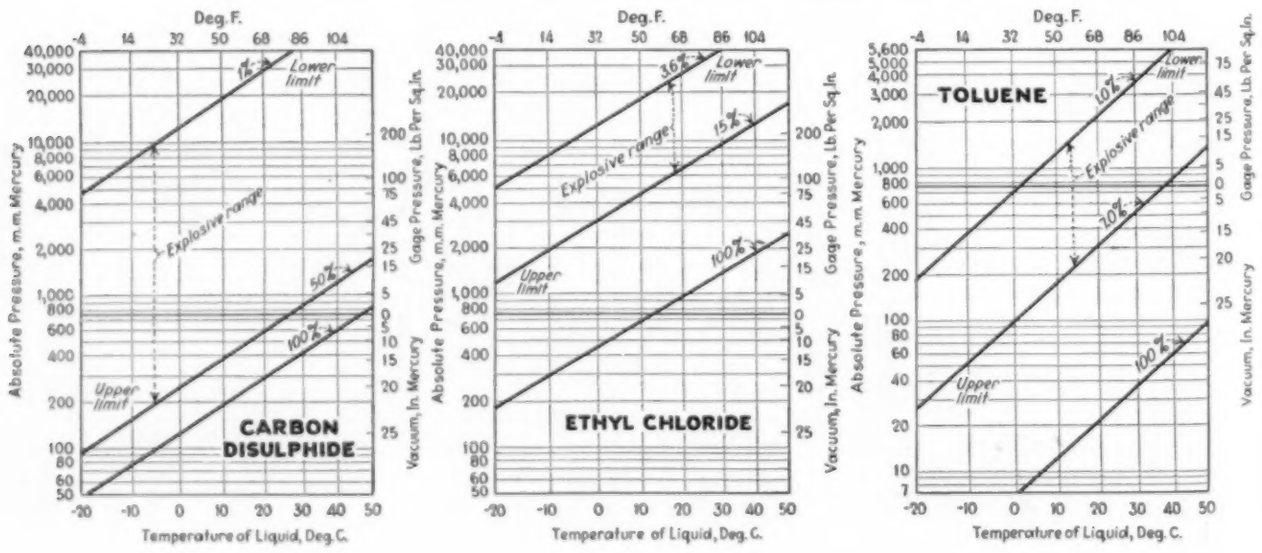
From these charts it will be seen that in the region of the lower limits, increasing the pressure and decreasing the temperature makes conditions less hazardous, while in the region of the upper limits, increasing the temperature and decreasing the pressure makes conditions less hazardous.

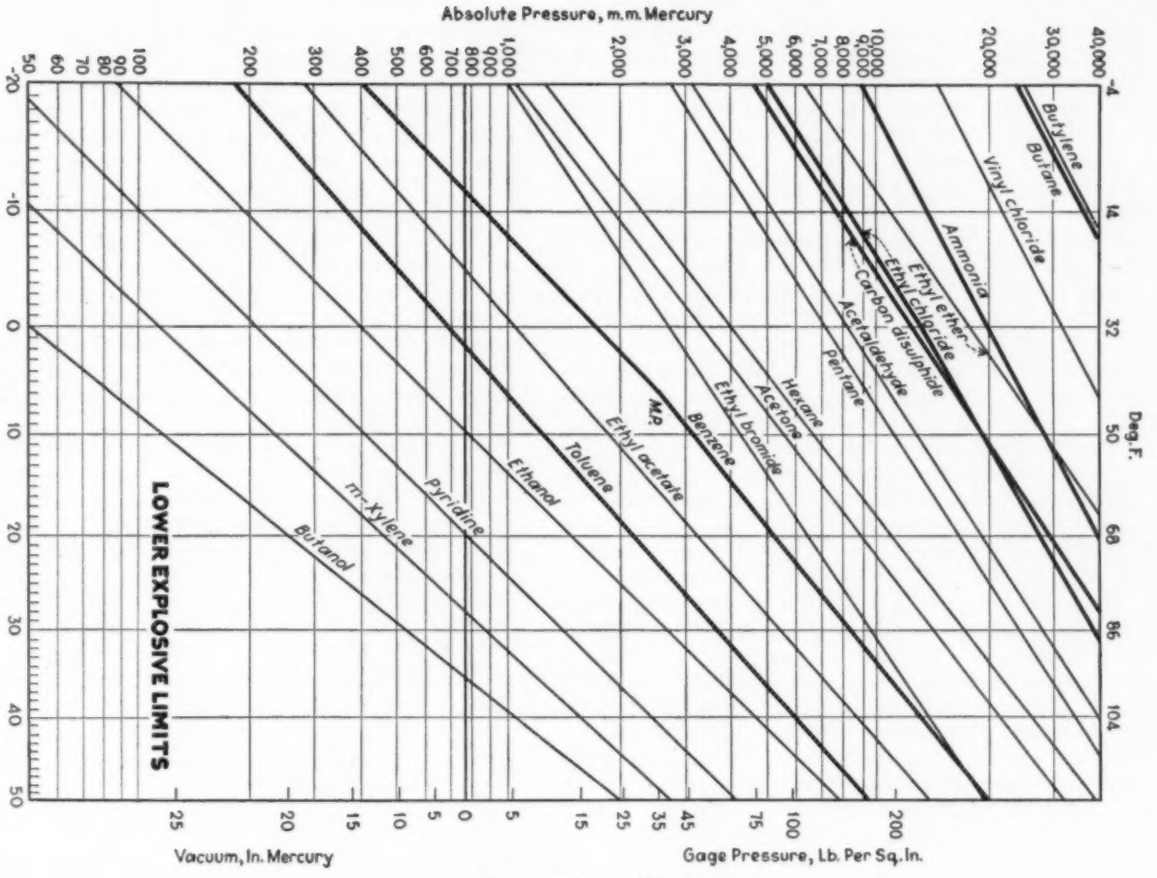
A tank partly filled with liquid ethyl chloride and air at a pressure of 40 lb. per sq.in. is less hazardous at 30 deg. C. than at —10 deg. C. Conversely, toluene under air at a pressure of 40 lb. per sq.in. is more hazardous at 30 deg. C. than at —10 deg. C. In similar manner, conditions within a storage tank of gasoline at atmospheric pressure, where the vapor-air mixture is in the region of the upper limits, are less hazardous in the summer than in the winter, while with crude oil at atmospheric pressure, where the vapor-air mixture is in the region of the lower limits, conditions are more hazardous in the summer.

Impurities tend to lower vapor pressures and so in effect lower the position of the explosive range. However, this will normally be of concern only in cases where the temperature and pressure conditions are already close to the upper limit and where any lowering of this limit might bring conditions into the explosive range.

Thus far consideration has been given to vapor-air mixtures in equilibrium with the liquid inside a vessel. When vapors are permitted to mix freely with air, as from an open vessel or a leak in a closed vessel, then equilibrium can no longer be controlled. The entire range of composition is experienced—from 100 per cent vapor and 0 per cent air at the liquid interface or at the

Fig. 4-6: Pressure-temperature explosive ranges for some common flammable liquids





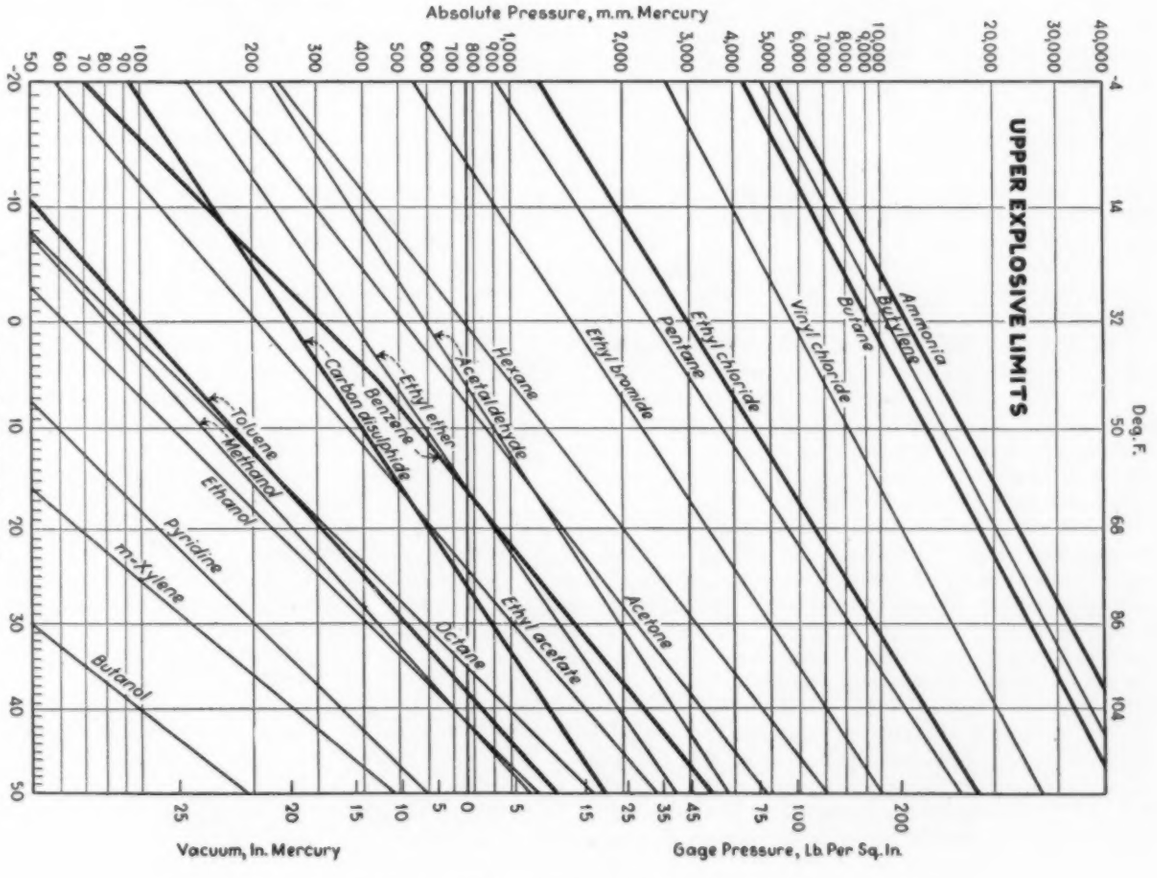


Fig. 7 and 8: Explosive limits of vapor-air mixtures expressed in terms of pressure and temperature at equilibrium

leak, to 0 per cent vapor and 100 per cent air some distance away. The only protection against such hazards is to reduce the volume of flammable vapors to an economic minimum by ventilation and, what is more important, reduce to a minimum all possible sources of leaks, not the least of which are pump stuffing boxes.

Flashpoints and Their Determination

Flashpoint is defined as "the temperature at which a liquid gives off vapor sufficient to form an ignitable mixture with air." Tables of flashpoints are based upon the so-called "open dish" method of measurement where the total pressure of the vapor-air mixture is considered to be 760 mm. absolute. It has already been observed[4] that the flashpoint of a liquid varies with barometric pressure at the same rate as does the boiling point of the liquid. Being by definition a measure of the minimum temperature at which sufficient vaporization occurs to form an ignitable mixture, flashpoint—at atmospheric conditions—should on the accompanying charts coincide with the intersection of the 760 mm. pressure line with the "too lean" or lower limit line.

The lower explosive limit line is then simply a measure of flashpoint over the whole pressure range. Failing to give flashpoint as a function of pressure may create a false sense of security since the lower limit line shows that the point of entrance into the danger zone varies with pressure. It is known that under vacuum an explosive mixture is possible at a temperature much below the tabulated flashpoint of the liquid. Xylene has a recorded flashpoint of 28 deg. C. Yet at 100 mm. pressure an explosive mixture will result at 0 deg. C.

Safe Handling Methods

To transfer liquids from one tank to another it is necessary to have the "energy level" of the liquid in tank No. 1 greater than that in tank No. 2 by an amount equivalent to the kinetic energy of transfer, or, it is necessary to supply this kinetic energy en route. The various methods by which this is accomplished and the safety considerations involved in each, are given in the following paragraphs:

1. The use of a compressed non-condensible gas to displace the liquid in tank No. 1 is often a convenient and economical method. As already mentioned, air can be used wherever the total pressure of the air-vapor mixture at the temperature experienced does not enter the explosive range. The method has advantages over pumps or mechanical devices which may present sources of leaks. It is necessary, however, to bring the air into the vessel in such a manner that the explosive range is passed through quickly and safely.

2. Heating tank No. 1 or cooling tank No. 2 is a method which takes advantage of the differential in vapor pressure resulting from the change in temperature. Installation costs become excessive if steam or brine have to be brought from any distance. The method offers an advantage over air blowing in that there will be no loss on purging. Operating costs, however, will generally run higher.

3. Reducing the pressure on tank No. 2 by applying suction is a method which entails considerable vapor loss unless a low temperature tailing condenser follows the tank. Air leaks in such a system are to be avoided as they may cause considerable loss of vapors along with the air that is carried out. If the reduced pressure is created by the suction of a compressor and the vapor is then compressed and discharged to tank No. 1 without condensation, as in unloading ammonia or chlorine tank cars, a condenser is unnecessary. The main precautions here consist of holding stuffing box leaks to a minimum and keeping the pressure in the system below that of the upper limits of explosive mixtures.

4. Displacement of the liquid in tank No. 1 by an immiscible liquid is a method which has been used with complete safety and high efficiency as evidenced by the patented Aqua system of displacing gasoline with water. Here the storage vessel is kept entirely free of air space in which explosive vapors might accumulate, thus making it one of the safest systems of handling flammable liquids under a wide range of temperatures and pressure conditions.

5. Pumping is undoubtedly the most familiar method for raising a liquid to a higher elevation and it needs no detailed discussion here. Pumps are usually economical to operate and entail low investment. Leaky stuffing boxes are frequently a source of hazardous vapor-air mixtures when flammable liquids are being handled.

In any system handling flammable liquids, lines coming from tanks or process vessels should always be fitted with slug or velocity check valves to minimize loss and prevent unloading and losing the entire contents of the tank in case the line is ruptured.

Ignition Temperatures

It does not necessarily follow that whenever an explosive mixture exists, an explosion will occur. Combustion or rapid oxidation will not take place unless the ignition temperature is reached and maintained, even though the liquid is hot enough to evolve vapors at a rate sufficient to produce an explosive mixture with air.

When excessive heat is produced, however, and is not dissipated at a sufficiently rapid rate, the temperature will rise and may reach the ignition point at which flame will result. Therefore dissipation of heat to avoid or control flame propagation is an important precaution in the handling of flammable liquids and vapors. It may be accomplished in several ways. In an internal combustion engine, the heat is removed as useful energy. In pipelines, flash screens or flame arresters are used. These serve to conduct the heat to the pipe, from which it is dissipated to the surrounding atmosphere. Failure of some flash screens is often due to the lack of sufficient contact with the pipe for dissipating the heat to it. Tubular heat exchangers in a system have in many cases proven to be efficient flame arresters.

In conclusion, the following precautions to be observed in handling flammable liquids are emphasized:

1. Control the composition of vapor-air mixtures to avoid the explosive range.

2. Prevent the reaching of ignition temperatures.

3. Provide for the dissipation of excessive heat and so arrest propagation of flame.

References

1. "Fire Hazard Properties of Certain Flammable Liquids, Gases and Volatile Solids." National Fire Protection Association, Boston, Mass., 1935.
2. Perry, J. H., Chemical Engineer's Handbook, McGraw-Hill Book Co., 1934, pp. 2486-7.
3. "Limits of Inflammability of Gases and Vapors." Bulletin No. 279, U. S. Department of Commerce, Bureau of Mines, 1928.
4. International Critical Tables, Vol. II, McGraw-Hill Book Co., p. 161.

Chemical Engineering Papers At St. Louis Meeting

EDITOR'S NOTE: Several of the important papers presented at the St. Louis meeting of the American Institute of Chemical Engineers, November 17-19, are published elsewhere in this issue. All will appear in the quarterly *Transactions of the American Institute of Chemical Engineers*, available from the office of the Secretary, 29 West 39th Street, New York City. Following are the official abstracts of other papers of interest to *Chem. & Met.* readers.

Resources of the Missouri And Mississippi Valleys in Relation to the St. Louis Metropolitan Area

Dr. Charles W. Cuno, consulting chemical engineer of St. Louis, stressed the importance and magnitude of the lead, zinc and iron industries in the St. Louis district, the bauxite, cinnabar and titanium deposits of Arkansas, the oil and gas resources, metallic and non-metallic minerals and those raw materials for chemical manufacture which are of peculiar significance in the district. In the opinion of the author, St. Louis urgently needs a new development of its oldest asset, the Mississippi River traffic, a more friendly cooperation from the railroads with the ultimate abolition of the much-discussed "bridge differential," further exploration of that treasure-house of natural resources, the Ozarks, and an added impetus to research and technology to supplement current university and industrial research organizations.

Particle Size Reduction And Separation

W. H. Coghill and F. D. DeVaney of the U. S. Bureau of Mines, at Rolla, Mo., traced the early development of this subject and compared various modern methods of size reduction when coupled with separation. The effects of various amounts of recirculation of partly ground material was discussed.

New Developments In Grinding

Lincoln T. Work of Columbia University, reviewed recent developments in grinding mill construction and presented a description of the more distinctive new mills. The normal improvements of standard mill types have consisted in the utilization of newer materials of construction and in varying combinations of drives, feeders, mills, classifiers and collectors. Problems of reducing energy consumption by more effective use of grinding forces, of lowering maintenance charges by minimizing wear on costly parts, and of classifying the material to obtain the desired size reduction well into sub-sieve sizes by control in design and operation—all these continue as dominant factors in the development of new types of mills. Some of these newer types include: the Gervais modified gyratory mill, the Hadsell mill, the Babcock and Wilcox ball roller mill, the Atlantis ball ring mill, the Vibratom vibrating pebble mill, and the new jet mills. Adjuncts to the grinding process include pre-conditioning of the material for grindability, the use of addition agents to avoid mill packing and to give desired qualities of the product and the use of flotation in connection with grinding and classification of non-metallic ores.

Effect of Grindability on Particle Size Distribution

R. M. Hardgrove of the Babcock & Wilcox Co., New York, reported that his method of determining grindability, which was developed first for coal and later used extensively on clinkers, cement rock and miscellaneous materials, has been found useful in predicting the capacity of all types of pulverizers. It has also been found to have a relation to the shape of the particle size distribution curve that makes possible the prediction of the approximate surface of the product corresponding to a given screen size. The paper includes a list of grindabilities of a variety of materials of chemical engineering interest.

Sedimentation of Flocculated Particles

C. B. Egolf of, Rohm & Haas Co., Bristol, Pa., and Prof. W. L. McCabe of Carnegie Institute have studied the sedimentation of flocculated particles using five different materials: (a) silica particles 16 μ in radius, (b) silica particles 5 μ in radius, (c) lead chromate, (d) zinc oxide and (e) ferric oxide. The temperature varied from 20 deg. to 40 deg. C., the initial heights of the suspensions from 12.5 to 61.7 cms. The concentrations varied from the point where the suspension no longer settled with a sharp line up to the concentration where free settling was no longer exhibited.

A method of reconstructing the curves, will divide the process into the initial straightline or free settling period and the final or compression period. The general accuracy of the reconstruction is considered satisfactory.

Absorption of Nitrogen Dioxide By Aqueous Solutions

F. S. Chambers, Jr. and T. K. Sherwood of M. I. T., reported experiments in which nitrogen dioxide was absorbed from a mixture in nitrogen using caustic solutions varying from 2.7 to 34.1 per cent NaOH and acid solutions varying from 5.7 to 69.8 per cent nitric acid. Similar tests were carried out in a wetted-wall tower and in a batch absorption vessel. The observed absorption rates for NO_2 were compared with corresponding rates of the evaporation of water in the same apparatus under similar conditions.

The rate of absorption was found to go through a maximum for pure water and to be much less in strong acid or strong caustic. Even in the strong solutions the rate of absorption was found to be proportional to approximately the 0.8 power of the gas velocity, indicating the gas film diffusional resistance to be controlling.

Metal Knit Cloth Tower Packing And Its Use in Plate Columns

F. C. Vilbrandt, E. D. Shuffle, Jr., and S. B. Row of Virginia Polytechnic Institute, Blacksburg, Va., reported that hose knitted coarsely from fine metal (copper) ribbon can be rolled up to form cylindrical units or simply allowed to pile up to form tower packing of low weight with high surface per unit of volume. Pressure drop, measured at flows up to about 30 ft. per min. was about the same as for 1 in. Raschig rings.

The effect upon plate efficiency of inserting a 1.5-in. thick unit of this material above each of two single-cap distillation column plates, 8 in. in diameter was determined with two different still bodies; the results of the two series are not closely comparable, but it was found in general that the plate efficiency, already about 100 per cent, was enhanced so much by the packing unit that it was still this high when the cap was removed altogether.

Performance of Bubble Plate Columns

Mott Souders, Jr., of Yale University, R. L. Huntington of the University of Oklahoma, H. G. Corneil, of Humble Oil & Refining Co., Bayton, Tex., and F. L. Emert of the Phillips Petroleum Co., Borger, Tex., have obtained original data on froth heights and pressure differentials in a bubble-plate column, by observing the performance of air-kerosene and air-lubricating oil systems in a visible glass section.

Chemical Engineer's BOOKSHELF

Omnibus of Rubber Chemistry

CHEMISTRY AND TECHNOLOGY OF RUBBER. A.C.S. Monograph Series No. 74. Edited by Carroll C. Davis and John T. Blake. Published by the Reinhold Publishing Corp., New York City. 941 pages. Price $15.

Reviewed by *R. L. Taylor*

THE National Bureau of Standards, Washington, D. C., recently published a 19-page pamphlet listing those books and periodicals on rubber which it considered to be of greatest importance to American readers. The list was not intended to be exhaustive. It did indicate, however, that for a person interested in making a general study of the chemistry and technology of rubber, any attempt to wade through only the most significant of the literature would at least be exhaustive in the physical sense.

In this A.C.S. monograph the editors have called upon 38 specialists to digest and present in readable as well as useful form the most important knowledge in their respective branches of the rubber field. This method of presentation has resulted in exceptional coverage of ground for a single volume. And while the multiple authorship has meant some sacrifice of unity and coherence, the individual contributions are in most cases essentially complete.

From the standpoint of chemical engineering interest, the chapters on mastication, compounding, vulcanization, and physical properties will be most valuable. As a whole, however, the book gives considerably more space to the pure chemistry of rubber than to its technology. Very little is said of manufacturing methods or industrial practice. Also it would have been helpful if more had been included on the resistance of rubber to various chemicals. The outstanding chapters, in addition to those on the pure chemistry of rubber, are those on the effects of the various compounding ingredients, the physical characteristics of rubber, latex and its applications, synthetic rubbers, reclaimed rubber, commercial rubber derivatives and literature on the chemistry of rubber.

The book is well written and edited, and the subject and author indexes are good. Adding to its utility are the extensive lists of references at the end of each chapter. In final analysis, it is the opinion of this reviewer that the book is probably the best available on the chemistry of rubber—both theoretical and applied, and as such will be a valuable addition to any technical reference shelf.

AN OLD PROFESSIONAL FRIEND

PRINCIPLES OF CHEMICAL ENGINEERING. By *William H. Walker, Warren K. Lewis, William H. McAdams* and *Edwin R. Gilliland*. Published by the McGraw-Hill Book Co., Inc., New York City. 749 pages. Price $5.50.

Reviewed by *Barnett F. Dodge*

THE THIRD EDITION of this pioneer text in the field of chemical engineering unit operations appears with another name added to the well-known triumvirate—a fact which must be somewhat disconcerting to the generations of students who have always known it (more or less affectionately) as "Walker, Lewis and McAdams". The revision, as stated in the preface, is entirely the work of Professor McAdams and the new collaborator, Professor Gilliland. Death, on the one hand and circumstances on the other, have prevented the collaboration of Dr. Walker and Dr. Lewis.

The best service that the writer can perform in this review is to point out the ways in which the new edition differs from the second which appeared ten years ago. First, as to general outline, the number of chapters and their general content remains the same; there is some rearrangement in the order of the last six and the chapter formerly entitled "Humidifiers, Dehumidifiers and Water Coolers" is now "Air Conditioning". The total number of pages is 20 less than in the second edition.

When one compares the two editions in detail one finds that the authors have not made a uniform revision to bring all parts up to the 1937 level of advance in the science and the art of chemical engineering. Considering the great strides taken in the past decade, this would have been a gigantic task and the authors have undoubtedly been wise to confine themselves to those fields with which they are best acquainted.

Revision has been the most extensive in the chapters on flow of fluids and flow of heat. In fact one can say that these two chapters have been practically re-written and much new material added. The chapters on industrial stoichiometry, fluid films, crushing and grinding, mechanical separation, filtration, evaporation, general principles of diffusional processes, absorption and extraction, distillation, humidity and wet- and dry-bulb thermometry, air conditioning and drying have been revised to varying degrees but not to an extent comparable to the two chapters first mentioned.

The chapters on fuels and power, combustion, furnaces and kilns, gas producers, and basic principles of vaporization processes are either wholly unchanged or have had a very slight revision in the phrasing in a few places but no new material added.

In the industrial stoichiometry chapter there have been added new specific heat data for gases, revised Hildebrand and Cox charts and a new section dealing with systems of units and dimensional similitude. The number of numerical illustrations has been reduced from three to one.

In "Fluid Films" there has been considerable revision in the phrasing but little new material added.

"Crushing and Grinding" is unchanged except for brief description of a few additional types of mills and the addition of a short section on particle size measurement.

The only change in "Mechanical Separation" is in the section dealing with the motion of particles in fluid media. The quantitative treatment of filtration has been completely revised and one new problem worked out.

Changes in the evaporation chapter are confined to one new paragraph on optimum cleaning cycle, a new illustration and a few additions to the section on heat transfer coefficients. In "General Principles of Diffusional Processes" the mathematical treatment of diffusion and transfer coefficients has been rewritten.

In "Absorption and Extraction" there are new sections on plate towers, H. T. U. and H. E. T. P., some new numerical illustrations and considerable revision of the section giving tranfer coefficients.

In the distillation chapter there has been considerable rearrangement of subject matter and some new material and new illustrations added. In the three remaining chapters—"Humidity, and Wet- and Dry-Bulb Thermometry," "Air Conditioning" and "Drying"—there have been extensive revisions in the mathematical treatment, with the

sections on general principles and equipment little changed.

Faced with a difficult task demanding no little exercise of courage and good judgment the authors have risen to the occasion and produced a new edition that is worthy to carry on in the tradition of its predecessors.

A NEW THORPE'S

THORPE'S DICTIONARY OF APPLIED CHEMISTRY, VOL. I (A-BI). Fourth Edition. By *J. F. Thorpe* and *M. A. Whiteley*. Published by Longmans, Green & Co., New York City. 703 pages. Price, $25.

AN ENTIRELY NEW and revised edition of the well known Thorpe's Dictionary series is inaugurated with the publication of this new Volume I. It is the plan of the publishers to proceed with the new edition at the rate of one volume per year until the series of nine is completed. The last volume is to contain a general index and glossary for the whole set.

A comparison of the present volume with the corresponding one in the last edition, which, incidentally, appeared just sixteen years ago, shows that over one hundred additional pages have been used in covering the same alphabetical ground, also that a larger part of the work has been turned over to contributors carefully selected from the ranks of well-known English experts. A thorough job has been done in bringing the volume up to date. A large number of the more important subjects are treated in an extensive monographical form, a feature which offers notable contrast with the straight dictionary style of the previous edition. To cite several random examples, four pages have been devoted to the general subject of acetate silk dyes, six and one-half pages to autoclaves, and five pages to the principle and applications of the absorption process.

It is planned that the series will be kept up to date by including new material in the succeeding volumes.

NOMOGRAPHY EXPLAINED

HOW TO MAKE ALIGNMENT CHARTS. By *Merrill G. Van Voorhis*. Published by the McGraw-Hill Book Co., Inc., New York City. 114 pages. Price, $2.50.

Reviewed by *D. S. Davis*

GROWING RECOGNITION of the value of rapid, convenient and practically error-proof graphical methods for the solution of engineering formulae has prompted Van Voorhis' worthwhile contribution to the field of nomography. The new volume should find friends among (1) engineers without previous training along these lines who are anxious to learn to construct their own charts without concerning themselves greatly with the underlying theory and (2) the many who have had formal courses in the subject only to find themselves unable, after a time, to apply their knowledge satisfactorily.

The author, relegating theory to a terse but unusually adequate appendix, has supplemented the more precise "formula methods" with construction methods where possible. Valuable features include a list of general type equations denuded of functional notation to facilitate identification with practical problems, excellent line-cuts of generous proportions, descriptive matter on the same page with the related figure, and a consistent scheme of presentation.

For purposes of study the means suggested for laying off the scales are entirely sufficient although they are not those which the nomographer, as he gains experience, is likely to continue to use. More detailed material covering the very useful line-coordinate type would be a welcome addition to a book distinguished for its clarity and freedom from errors.

COLORIMETRIC TWIN

COLORIMETRIC METHODS OF ANALYSIS. Vol. II—Organic and Biological. By *F. D.* and *C. T. Snell*. Published by D. Van Nostrand, Inc., New York City. 815 pages. Price $9.50.

Reviewed by *W. L. Abramowitz*

IN DESCRIBING Vol. I which covers colorimetric inorganic analysis, this reviewer stated in a previous issue of *Chem. & Met.* that the infant volume begotten by Dr. Snell in 1921, had grown to a lusty maturity. We apologize for the understatement—the "infant volume" is now twins. The two volumes together now constitute a complete presentation of colorimetric and related methods of analysis.

In Vol. I has been placed most of the definitions, art, laws, and descriptions of apparatus. The present book, supported by that foundation, is devoted almost entirely to analytical methods. Somewhat unfortunately for general organic and industrial chemists, the biological applications predominate. This is to be expected, however, inasmuch as the biochemical field was the first to extensively require colorimetric methods. Much space is given to the purine group, tyrosine, tryptophane, histidine, amino acids, hemoglobin, enzymes, hormones, and vitamins. Chapters of general interest include those on the determination of fatty and aromatic alcohols, aldehydes, ketones, carboxylic acids, sugars and carbohydrates, lecithin, and sterols.

Lately intensive industrial research has been going on in tracing spectrophotometrically the efficacy of bleaching and refining agents on fatty oils. In one series of experiments known to the reviewer, the color of a raw fatty oil was plotted by a Hardy color analyzer. The oil was then treated with specific bleaching and decolorizing agents, each of which eradicated definite portions of the color curve. A most efficient blend of bleaching agents was then compounded to remove the en-

RECENT BOOKS AND PAMPHLETS

Asphaltos e Sapropelitos, by S. Froes Abreu and R. Roquette, Instituto Nacional de Technologia, Rio de Janeiro, Brazil. 84 pages. The chemical and physical properties and geological characteristics of asphalt and sapropelic coal and their occurrence in Brazil and some other South American regions.

Copaes do Brasil, by Jose Rangel and Haya Schneider, Instituto Nacional de Technologia, Rio de Janeiro, Brazil. 41 pages. An account of the properties of natural resins obtained as exudates from the "jatoba, trapoca and jutahycica" trees of Brazil.

Cornstalk Accoustical Board, by L. K. Arnold, H. J. Plagge, and D. E. Anderson, Bulletin No. 137, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa. Describes apparatus devised for determining the coefficients of sound absorption of acoustical boards. Studies of the effect of composition of the pulp used and the surface treatment given the boards tested are discussed.

Insulating Board, Studies on the Manufacture of, by O. R. Sweeney and L. K. Arnold, Bulletin No. 136, Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa. 75 pages. A report of results of recent research at Iowa State College, this bulletin describes the new forming machine developed for making cornstalks and other agricultural byproducts into insulating board; includes discussion of the newer methods of pulp preparation and studies of drying, sizing, air infiltration of the board and dusting of the board.

Lubricants, Symposium on, 1937, American Society for Testing Materials, Philadelphia, Pa. 89 pages. The four technical papers and discussion comprising this symposium are limited to motor car engine lubrication. The subjects of the papers are as follows: 'Automotive Bearings—Effect of Design and Composition on Lubrication; Engine Deposits—Causes and Effects; Addition Agents for Motor Oils; How to Select a Motor Oil from the Standpoint of the Consumer. Price, $1.25 paper cover, $1.50 cloth.

Lubrication and Lubricants, General Discussion on, Institution of Mechanical Engineers, Storey's Gate, London, S.W.1. A wealth of technical information and data by a large number of English contributors. Presented in four separate books under following subject divisions Group I. Journal and Thrust Bearings, 300 pages; Group II, Engine Lubrication, 216 pages; Group III, Industrial Applications, 161 pages; Group IV, Properties and Testing, 226 pages. Price per group, 2s. 6d.

The Origin and Constitution of Matter, by Howard A. Redfield. Published by George Hillenbrand, Monterey Park, Calif. 46 pages. A mathematical and graphical approach to the problem of the constitution of matter and the fundamental theories relating to atomic shapes, molecular shapes, crystalline shapes, variable valence, isotopic equivalence and family resemblances in the periodic table.

Physikalische Methoden in chemischen Laboratorium, Verlag Chemie, G.m.b.H., Berlin, Germany. 267 pages. A detailed survey of the various physical methods used in the chemical laboratory, mostly pertaining to analysis. Printed in German. Price, RM 2.70.

Technical Books of All Publishers, Chemical Publishing Co., New York City. A 133 page catalog in which are listed according to subject the name, authors, price, and brief statement of content of the leading technical books of all American publishers. Price, 10 cents to technical workers, 30 cents to others.

tire color curve and leave a very light oil.

The Snells have wisely covered work of this type comprehensively and present reviews on the measurement of bleaching and decolorizing power and on the determination of color in various oils, varnishes, foodstuffs, fabrics and other important industrial products.

CATALOGS AND DIRECTORIES

CHEMICAL ENGINEERING CATALOG, 1937. Twenty-second annual edition. Published by the Reinhold Publishing Corp., New York City. 1,034 pages.

THE CATALOG is still growing, both in size and usefulness. In the present edition 485 firms are represented as against 446 in 1936, and they use a total of 824 pages in describing their products where only 699 were used in the last edition. It is noted that in general the quality of the data and descriptive matter on these pages has also improved this year. More really useful engineering information and actual operating and installation data are included. The indexes have been revised and the book section brought up to date to include recent technical books of all publishers.

MINES REGISTER. Volume XIX. Published by Atlas Pub. Co., Inc., New York City. 1,622 pages. Price, $25.

AS SUCCESSOR to the "Mines Handbook", last published in 1931, this directory contains such information as address, officers, capitalization, property, development, equipment and in some cases production, for each of about 4,000 active mining companies in the Western Hemisphere. There is also a statistical section which gives figures on production, consumption, imports, exports and prices of non-ferrous metals. A "who's who" of mining officers and directors lists about 10,000 names and company affiliations.

MODERN PLASTICS CATALOG AND DIRECTORY, 1937. Published by the Breskin & Charlton Publishing Corp., New York City. 342 pages. Price, $2.

THE SECOND in *Modern Plastics'* series of annual catalog and review numbers follows along in the ultra-smart, eye-pleasing style of its predecessor. The editorial reports on recent progress in applications and molding technique for the various types of plastics are thorough but in some cases tend to carry that slight tinge of the promotional aspect which it is so difficult for authors affiliated with producers to avoid. Directories of trade names, raw materials, physical properties, equipment manufacturers, molders, fabricators and designers are again included.

CHEMISTRY OF BREWING

BIOCHEMISTRY APPLIED TO MALTING AND BREWING.. By *R. H. Hopkins* and *B. Krause*. Published by D. Van Nostrand Co., Inc., New York City. 342 pages. Price, $4.50.

Reviewed by *William Siebenberg*

This excellent publication fills a real need of brewing chemists and technologists. The book presents the principles of biochemistry as applied to malting and brewing procedure from a theoretical standpoint, and a knowledge of the practical processes is therefore assumed.

Chapter I reviews some of the important principles of physical chemistry dealing with diffusion, electrolytic dissociation, pH, buffer solution, oxidation-reduction, etc. Chapter II discusses the general chemistry of raw materials used in malting and brewing and deals with carbohydrates, fats, proteins, tannins, essential oils, bitter acids, resins, enzymes, and vitamins. A select list of textbooks and references follows. Chapter III covers the biochemical changes occurring in the barley in the course of steeping, germination, drying and storage. Chapter IV presents the brewing processes and systematically discusses composition of brewing waters, mashing, effect of pH on quality and quantity of extract, hops, the cause and effects of boiling and cooling of the wort, and the composition of the spent grains. Chapter V discusses yeast and fermentation, conditioning of beer, filtration and pasteurizing, and the biological and physiological stability of beer.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Skin Hazards in American Industry, by Drs. Louis Schwartz and Louis Tulipan. Public Health Service, Bulletin 215; 1937 revision; 15 cents.

Report of Comparative Study of Liquid Insecticides, by Commander F. S. Johnson and Arthur G. Vallee. U. S. Naval Medical Bulletin, July, 1937, vol. XXXV, No. 3; 25 cents.

Fumigants, by C. L. Williams. Public Health Service Reprint No. 1473, Revised 1937; 5 cents.

Carbon Tetrachloride Poisoning. Division of Labor Standards, Industrial Health and Safety Series No. 11; 5 cents.

Regulations for the Control of Arsphenamine, Neoarsphenamine, and Sodium Arsphenamine in the District of Columbia and Interstate Traffic. Public Health Service, Miscellaneous Publication 22; 5 cents.

Stickers for Derris on Cabbage and Beans, by Robert A. Fulton. Bureau of Entomology and Plant Quarantine, ET-107; mimeographed.

A Method for Preventing Insect Injury to Material Used for Posts, Poles, and Rustic Construction (with zinc and copper salts), by F. C. Craighead and others. Bureau of Entomology and Plant Quarantine, E-409; mimeographed.

List of Publications of the Division of Insecticide Investigations, July 1, 1927 to June 30, 1937. Bureau of Entomology and Plant Quarantine; mimeographed.

Labor Productivity in the Leather Industry, by John R. Arnold. Bureau of Labor Statistics Serial No. R. 596.

Flaxseed Production in the Far Western States. Department of Agriculture, Farmers' Bulletin 1793; 5 cents.

Flow of Water Through Six-Inch Pipe Bends. Department of Agriculture, Technical Bulletin 577; 15 cents.

Yearbook of Agriculture, 1937. Department of Agriculture unnumbered book. 1497 pages; $2.00 (vellum).

The Sterilization of Wool and its Effect on Physical and Chemical Properties of a Wool Fabric, by Harry Humfeld and others. Department of Agriculture Technical Bulletin 588; 5 cents.

Digest of Interpretations of Regulations No. 5 Relating to Labeling and Advertising of Distilled Spirits. Federal Alcohol Administration Division Supplement No. 1; mimeo.

Electrical Thermometers for Aircraft. National Advisory Committee for Aeronautics Report No. 606; 10 cents.

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Your Plant NOTEBOOK

ADVANTAGES OF PREDRYING WOOD IN WOOD DISTILLATION PLANTS

By T. C. ALBIN
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Although directly applicable only to the wood distillation industry, this analysis suggests a method of approach to many problems in other process industries. As an example of logical deduction alone, it is well worth study.

STEAM CONSUMPTION of a given wood distillation plant is directly proportional to the quantity of water that must be distilled off in recovering the products. In an average cord of wood the moisture-free wood substance will amount to 3,000 lb. and when carbonized will give about 165 gal. of pyroligneous acid with a weight of 1,375 lb. Any moisture in the wood as charged into the retorts is vaporized and appears in the pyroligneous acid. Green wood will carry 40 to 45 per cent or in the neighborhood of 2,000 lb. or 240 gal. of water. The moisture content of air-dry wood varies with the climate and the season but will average around 20 per cent which is equivalent to about 750 lb. or 90 gal. of water per cord.

Obviously the volume of pyroligneous acid per cord may vary from 165 + 240 = 405 gal. with green wood, to 165 + 90 = 255 gal. with air-dry wood. The difference amounts to 1,250 lb. of water per cord. Total steam for processing pyroligneous acid will be 2 lb. or more per pound of water eliminated so the equivalent of the 1,250 lb. of water is 2,500 lb. of steam which, at 30 cents per 1,000 lb., gives 75 cents per cord as the saving in the steam cost alone, by using air-dry wood.

To air-dry wood down to 20 per cent moisture requires 9 to 12 months storage so a plant carbonizing 100 cords per day must carry an inventory of about 30,000 cords representing an outlay of $100,000. At 6 per cent, the carrying charges would be $6,000 per year or about 20 cents per cord. About half the wood would be on the yard at the plant and it usually costs about 30 cents per cord to stock-pile it, or 15 cents per cord, when spread over the total wood supply. These charges take up 35 cents of the 75 cents saved in steam cost, leaving 40 cents per cord in favor of carrying a sufficient inventory to have dry wood.

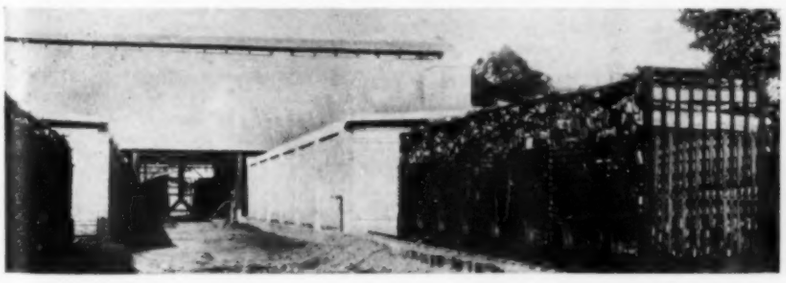
With predryers, the wood inventory may be reduced by 50 per cent which will reduce the carrying charge to about 10 cents per cord. When using green wood, the predryers will reduce the moisture content to about 20 per cent or practically the same as after 9 to 10 months storage. On account of the seasonal nature of woods operations, the wood arriving at most plants has been cut 3 to 4 months and the predryers will reduce the moisture in such wood to around 12 per cent, equivalent to 400 lb. of water per cord. This is 350 lb. per cord less than in air-dry wood and represents a steam saving of about 10 cents per cord. The total saving in favor of predrying, as compared to air-drying is, thus, 20 cents per cord. The power cost chargeable to operating the predryer fans, which circulate the hot gases, will be about 5 cents per cord, leaving a net of 15 cents per cord.

When steam is produced by burning sawmill waste, furnace gas, etc., the saving, as calculated above, will be too high. However, there are other advantages in using dry wood which are difficult to convert into dollars and cents. The lower volume of liquor from dry wood means a reduction in the quantity of cooling water required. It also permits a reduction in the size and capacity of the distilling equipment. Shut-downs for cleaning are much less frequent when using the more concentrated pyroligneous acid. No recovery process is 100 per cent efficient and there are always small percentages of alcohol and acid in the waste liquors from the plant. As these losses are proportional to the volume of liquor handled, they become smaller with predrying, owing to the smaller quantity of liquor processed.

The reduction in wood inventory possible at plants using predryers has an important bearing on plant operation apart from the saving in carrying charges. When hard times come and prices drop, as they do periodically, the plant with a large wood inventory is in a bad way. If it is necessary to shut down for a period of several months, part of the wood on hand becomes "dozy" and gives low yields when finally put through the plant. The only other alternative is to continue running until the wood is used up, converting high-priced wood into low-priced product and still further flooding a declining market. When operations are resumed, the necessity of building up the wood inventory as quickly as possible leads to a rapid increase in the rates for chopping and hauling wood.

A plant with predryers and a relatively low wood inventory is in a much better position to accommodate its operations to changing conditions, both in falling and in rising markets. While the inventory is being built up the predryers will keep the moisture content of the wood low enough for efficient operation. The money value of these advantages is difficult to estimate but is considered sufficient to justify the use of predryers without taking into account the other savings effected by them in day-to-day plant operation.

Predryers in the wood distillation plant of Crossett Chemical Co., Crossett, Ark.



More on New Developments at the 16th Chemical Exposition

In its November issue *Chem. & Met.* devoted some 20 pages to an editorial Preview of new plant equipment and new construction materials to be shown at the 16th Exposition of Chemical Industries. As was to be expected, now that the Exposition has passed it is clear that the 200 new developments described there did not by any means cover all of the new things that the exhibitors had to show. Unavoidably some of the equipment described never reached the Exposition floor. More frequently, however, concrete plans had not been made at the time of our going to press and the necessary information was not then available to us.

In the report below the effort has been made to ferret out and describe all new chemical engineering developments at the Show which were not previously discussed. If the limitations of space and time have prevented complete attainment of this objective, the editors would like to be informed of specific omissions.

IN THE FOLLOWING pages are brief descriptions covering certain developments since the 1935 Chemical Exposition in the fields of drying and evaporating; filtering and centrifuging; grinding and homogenizing; mixing and agitating; and measuring, proportioning and controlling. In addition are descriptions of a group of interesting devices produced in special construction materials. Owing to the unexpectedly large number of new developments not covered in our November Preview of the Exposition, it has been necessary to withhold until our January issue the sections dealing with containers and packaging; materials and fluids handling; and electrical and miscellaneous equipment.—EDITOR.

Dryers and Evaporators

Improvements on the jacketed kettle dryer manufactured by C. O. Bartlett & Snow Co., Cleveland, Ohio, consisted chiefly in increasing strength to permit steam pressures up to 100 lb.; and elimination of the bottom bearing on the central shaft. Two other bearings on the shaft have been designed to carry the full load, leaving the entire bottom of the tank free.

Buffalo Foundry & Machine Co., Buffalo, N. Y., showed two improvements in connection with its double-drum dryers. One is a portable knife grinder which is readily used in grinding the knife without removing it from the machine. The other is a pendulum feeder for viscous materials in which the feed pipe is made to oscillate above the drums, feeding uniformly between them.

This same concern showed several evaporator developments, including a new salt separator for use on caustic and glycerine evaporators. The feature of this separator, which is for use on forced circulation evaporators, is a method of circulation permitting the maximum of opportunity for the salt to settle out before the liquor is withdrawn from the separator. It is then recirculated to the evaporator. One type of evaporator shown has recently been applied in place of a still in the recovery of solvents. In this application 99 per cent of the feed is recovered as solvent and only 1 per cent as finished product. Another improvement in evaporators is the use of a horizontal external heating body which permits the use of multi-pass construction, requiring little space for the heater and making for easy cleaning. Still another improvement employed in evaporators having a vertical external heater is a tangential inlet to the evaporator body which is said to aid materially in the separation of entrainment.

Goslin-Birmingham Corp., Birmingham, Ala., has developed a new type of forced circulation evaporator for use on concentrated products, for example, in the last effect of a multiple effect evaporator. This evaporator employs a horizontal external tubular heater through which the material being evaporated is forced by a pump. Discharge from the heater takes place tangentially within a cylindrical baffle inside the evaporator body, an arrangement which is said to be effective in separating entrainment from the vapor and returning it with the liquor recirculated through the pump and heater.

Link-Belt Co., Chicago, Ill., showed its rotary louver dryer which is new in the United States. Intended for all types of granular materials, the dryer consists of a horizontal rotating drum on the inside surface of which is a series of longitudinal channels of a depth about one-sixth the diameter of the drum. These channels are covered over their entire length by tangential plates which leave a gap for hot air, introduced at the end of the channels, to pass up through the material but prevent the material from falling down into the air passages. The hot air connection is so made that, as the drum revolves, only those channels which come underneath the charge are connected with the hot air supply and all gases must pass upward through the bed of material.

Filters and Centrifugals

A new product of the Ertel Engineering Co., New York, N. Y., is a filter press with plates made of hard rubber. The rubber is corrugated to allow drainage. Disks of asbestos are used as the filter medium and the shape of the plates is generally circular. Pipe and connections are also made entirely of hard rubber. Advantages claimed by the manufacturer include acid and alkali resistance at low cost, as well as increased capacity.

A new type of vacuum drum filter shown by the Goslin-Birmingham Corp., Birmingham, Ala., featured a vapor tight hood over the drum, a type of construction which has been applied to filters used in the dewaxing of lubricating oils.

An interesting redesign of the recently, developed cord filter was evident in the Louisville-Wright filter shown by the Louisville Drying Machinery Co., Louisville, Ky. This device, first shown at the Chemical Exposition in 1935, retains the same

basic principles, although the execution has been modified considerably. Originally the cords which serve both as the filter medium and the discharge means were carried in grooves in the drum, piped to the source of vacuum. In the improved machine, two sets of cords are used, one parallel set serving as the grooves for a second superimposed set. As a matter of fact, each set consists of one continuous cord, so that only two joints are required. The surface of the drum is formed into a number of compartments, each of which is piped to the vacuum source. Filtrate is drawn between the cords, while the solids are deposited on their surface, to be withdrawn from the drum after air has been sucked through for partial drying. No blow-back is required to assist discharge. The cords are washed individually and then returned to the drum.

A two-motor drive for centrifugals, one motor used for high speed operation and the other for constant low speed during unloading, was exhibited by the American Tool & Machine Co., Hyde Park, Mass. The high speed drive motor is direct-connected to the basket shaft through a flexible coupling, while the smaller motor, which is used for "plowing out," turns the basket through a worm and worm gear. A free-wheeling device is contained within the worm gear which permits the main motor when operating under its own power simply to over-run the low speed connection. Also shown by this company was a new continuous skimmer used for taking off the narrow rim of clear light liquid which collects at the upper periphery of the centrifugal basket.

A novel design of basket for use with suspended centrifugals was shown by the Fletcher Works, Philadelphia. This is the "McGlaughlin-Patents" machine which is built in sizes from 20 to 48 in. diameter. It is an all purpose basket, for both filtering and decanting and differs markedly from earlier designs. The solid basket is provided with annular ribs and both the inner periphery and the ribs are covered with a wire grid backing and with filter cloth. Air and washing connections are made through the hollow shaft. The filtering surface is much extended by this construction so that a greater thickness of solids can be built up. These are discharged by blowing the filter bag inward by air pressure. Before discharge, back-washing can be accomplished by introducing the washing liquid behind the filter cloth. A skimmer pipe is provided for non-filterable materials.

Rochester Engineering & Centrifugal Corp., Rochester, N. Y., showed two new developments, one a suspended centrifugal equipped with a new drive, making possible a high and a low speed with a single motor. Thus, with a high operating speed of 750 r.p.m., the drive permits a low speed of 60 r.p.m. for unloading. Using a two-speed motor, two high and two low speeds can be obtained. The same company exhibited a new semi-continuous centrifugal with automatic cycle control, capable of carrying out any predetermined operating cycle that may be desired.

Sharples Specialty Co., Philadelphia, Pa., exhibited for the first time some of the special equipment which it manufactures for use in processes employing its centrifugal separation equipment. One of these devices is a proportioning pump to which has been given the name Proportionometer. This is used in oil treating processes where the oil, flowing through a displacement meter, serves to pace a steam pump. The pump meters a treating chemical such as caustic soda or sulphuric acid and both chemical and oil are then discharged into a second piece of equipment, a high speed contactor. The latter is a horizontal trough divided into several compartments connected only along a horizontal shaft carrying high-speed agitating elements, one of which is situated in each of the compartments.

Grinding and Homogenizing Equipment

Pulverizing Machinery Co., Roselle Park, N. J., has added a wet-milling machine to its regular line of Mikro-Pulverizers. The machine is designed to handle sludges, slurries and liquids containing lumpy material such as chunks of pigment or filter cake. It is similar in construction to the company's standard type of machine except in the method feeding. In the feed hopper are two rotating agitators which serve to break up lumps and keep the solids in suspension. A single feed screw delivers the material at a uniform rate to the grinding chamber where a rapidly rotating drum carrying numerous pivoted knife-like hammers grinds the material prior to its passage through a fine screen.

An homogenizer which is new in the United States, having been developed and used previously in England, was shown by the Abbe Engineering Co., New York. It operates according to a principle said to be new to this type of apparatus. A single cylinder pump is used, discharging through a spring-loaded valve which opens to permit a portion of the liquid to escape at high velocity through the narrow orifice between seat and disk. The action results in a high degree of turbulence and in the alternate application and release of pressure, giving the machine its name of "Impulsor."

Although still in the experimental stage, a new high-speed homogenizer was shown by Bowen Research Corp., Garwood, N. J. The operating part of the machine is a horizontal disk which rotates at speeds ranging from 14,000 to 28,000 r.p.m. The upper side of the disk is channeled in such a way that the outward progress of a liquid introduced at its center is retarded by numerous baffles provided in the channeling. With the liquid traveling at high speed, the effect is to produce an extreme dispersion of particles. As yet application of the new machine has been confined to foods such as milk and cheese, but uses in inks and paints are expected to follow quickly, and experiments have already been conducted on dyes.

Mixers and Agitators

In the new Glen mixer exhibited by American Machine & Foundry Co., New York, all operations are auto-

matic. The beater may be raised, the bowl released and the speed altered simply by pressing a button. Infinite speed variation is provided by a Reeves Vari-speed drive. An eccentric from which the beater is suspended provides a double rotary motion, i.e., rotation of the beater about its axis and rotation of the beater axis about a central shaft. Advantages claimed include a dust-tight bowl (insulated with sponge rubber); ability to handle either liquid, paste or solid; and even distribution of wear on the bowl resulting from the fact that the beater strikes at a different place during each revolution.

A new development of the J. H. Day Co., Cincinnati, Ohio, is called the Pony mixer. It is an open-type mixer with both revolving bowl and revolving beater. The beater consists of four pieces of twisted steel bar of rectangular cross section, suspended from a gear head placed over the bowl. This gear head is pivoted and counterbalanced in such a manner that it permits the beater readily to be lifted from the bowl by hand.

Mixing of such materials as pigments under either increased or diminished pressure is said to be done effectively in the new mixer exhibited by Adolphe Hurst & Co., New York. The beater, an oval-shaped ring of steel with various cross bars, is mounted on a shaft which extends through the bottom of the bowl at an angle of about 45 deg. On the lower end of the shaft is a pinion which travels around on a ring gear, giving the beater a rotary motion about the center of the bowl bottom. In addition, the beater is rotated on its own axis, producing a thorough mixing action, according to the manufacturers.

On one of its Lightnin mixers of the side-entering type, Mixing Equipment Co., Rochester, N. Y., showed a new double stuffing box. One box is on the inside of the vessel wall to protect the shaft bearing and the other on the outside so that in case of a leak it can be repacked without emptying the contents of the vessel.

A new side-drive agitator was demonstrated by the New England Tank & Tower Co., Everett, Mass. This device is a direct motor-driven propeller which, in the new arrangement shown, was developed for dissolving milk of magnesia. It is installed radially in the tank side with the shaft at an angle so that the circulation produced is directed toward the far side of the tank bottom.

U. S. Stoneware Co., Akron, Ohio, exhibited one of its new Tornadic portable mixers which feature light weight, compactness and adjustability of shaft length. Such mixers can be produced in practically any metal or alloy desired.

American Meter Co., New York, showed a new explosion-proof, air-operated orifice flowmeter of the recording type.

Builders Iron Foundry, Providence, R. I., and its associated company, Proportioneers, Inc., demonstrated a system for obtaining proportionate flows of two dry materials. One material was carried on an indicating and recording conveyor scale where any variation in flow was transmitted from the scale mechanism through a Chronoflo electrical transmitter to the electric flow control on a Syntron dry feeder. This feeder then delivered the second material at a rate proportionate to the flow of that on the belt.

The Coleman pH Electrometer, an instrument using the glass electrode, was exhibited by the N. J. Laboratory Supply Co., of Newark, N. J., and by W. A. Taylor & Co., of Baltimore, Md. The Coleman instrument is a compact, ruggedly constructed unit for industrial use and can be had with a continuous recording attachment.

New Level Indicator

A new device for indicating the level of material in a bin was exhibited by the Fuller Co., Catasauqua, Pa. The principal parts of the apparatus consist of a Telechron motor which rests upon the bin cover and a small metal paddle on the end of an adjustable shaft which reaches down into the bin and may be set at any desired level. The shaft and paddle are driven continuously at 1 r.p.m., and when the level of the material reaches and arrests rotation of the paddle the motor is driven about the axis of the shaft. This actuates a switch mechanism which may be employed to control the flow of material into the bin or give audible or visible warning when the material reaches or falls below a predetermined level.

A feature of the exhibit of the Gruendler Crusher & Pulverizer Co., New York, was the Mosher automatic pulverizer controller. By means of this controller, which operates by measuring the pulverizer motor load, a pulverizer may be operated at full capacity with no attention from the operator. Three signal lights on a panel indicate the condition of the equipment. One shows whether the feeder is operating, another whether the pulverizer is being operated up to capacity. If it is not, the feeder is started automatically. A third light warns of an overload condition, whereupon the feed is cut off automatically.

New in recent months is the Beckman pH meter developed and exhibited by National Technical Laboratories, Pasadena, Calif. It is designed for industrial use and gives a reading directly in pH when the electrodes are inserted into a few cubic centimeters of the solution being tested. Essentially it is a potentiometer with a milliammeter as the indicating device. A glass electrode, effectively shielded from external forces, and a standard calomel electrode, are the detectors.

Pittsburgh Equitable Meter Co., Pittsburgh, Pa. exhibited a new rotary meter for petroleum products, an instrument featuring low slip and great compactness. The metering element is of the true displacement type, the element consisting of a vane extending between a revolving drum and the wall of a cylindrical casing. Flow, in passing from the inlet to the outlet, follows a path of about 270 deg. Variation in viscosity over wide limits is said to have no effect on the accuracy. Pressure loss in passage through the meter is reported as being negligible.

Precision Scientific Co., Chicago, Ill., showed a new industrial oven temperature control device employing the expanding liquid principle. A coil of ½-in. metal tubing located inside the oven contains a fluid of high expansion coefficient which operates a pressure switch. The device is said to be extremely sensitive, capable of regulating oven temperature to within one-quarter of a degree.

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., demonstrated a new high speed multiple potentiometer recorder capable of printing 12 temperature records in about one minute. This company's Selectray recorder has been provided with a new arrangement whereby the printing interval can be shortened to half the normal if for any reason this is desired by the operator. This company exhibited a new controlling Selectray designed for controlling two different temperatures with the same instrument, as, for example, two different furnaces or two temperatures in the same furnace.

Wilkens-Anderson Co., Chicago, Ill., displayed the Cameron pH recorder for continuous process control. This instrument uses a glass electrode, making it possible to handle a number of liquids which the older hydrogen electrode could not measure satisfactorily. The exhibit was arranged so that the pH of the solution could be varied at will so that the recording of the change could be observed. An interesting feature of the recorder is a type of construction permitting recording on an ordinary sheet of graph paper.

WHAT'S NEW IN EQUIPMENT AND CONSTRUCTION MATERIALS?

Chemical Show Preview Which Appeared in November *Chem. & Met.'s* "After-the-fact" Continuation of the

Although not many new construction materials for plant equipment were exhibited at the Exposition there were a great many applications of special construction materials to novel uses. A number of these are described briefly below.

Construction Materials

Aluminum Co. of America, Pittsburgh, Pa., exhibited samples of Berl Saddle packing constructed of aluminum. This company also showed samples of refractories and grinding media formed of Tabular corundum, said to be an exceptionally pure form of alumina prepared by precipitation rather than fusion. High strength and temperature resistance are claimed for the refractories and other materials formed of such corundum.

American Hard Rubber Co., New York, featured an exhibition of unusually large molded pans for the viscose rayon industry, which reflected the trend in the construction of larger hard rubber parts. One new development was a joint for hard rubber pipe fittings. A soft rubber ring is now used as a bushing in the threaded joint to prevent leaking.

At the exhibit of the Corning Glass Co., Corning, N. Y., several recent developments of interest were shown. Outstanding was a 3-in. jet exhauster fabricated entirely from glass, one of the most difficult pieces of industrial glass equipment yet attempted. A 15-ft. length of 4½-in. glass pipe served to indicate the progress that has been made in producing longer sections in the large diameter sizes of this product. One article of special interest was a sight glass around the edge of which metal had been fused so that the glass could be soldered into a metal wall to give a permanent and gas-tight window.

New developments in Haveg, manufactured by the Haveg Corp., Newark, Del., other than those described in our earlier Preview, included a DeBothezat Bifurcator fan, the gas passage of which is molded of Haveg. Another new development was a one-piece molded horizontal tank, 5 ft. in diameter and 12 ft. long, used in the copper sulphate sweetening process for sour crudes, a use which has been developed by the Petroleum Research Engineering Corp.

A new line of stainless steel shovels for the handling of a variety of chemicals was exhibited by the Ingersoll-Steel & Disc Division of Borg-Warner Corp., Chicago, Ill.

M. A. Knight, Akron, Ohio, showed a number of new standard sizes of chemical stoneware slabs for tank construction, formed both solid and hollow. Such slabs are generally used with this company's Pyroflex plastic lining material as a backing, although in chromium plating tanks they may be laid up against the steel, set only in acidproof cement. New radial slabs were also shown together with samples of special shapes for conical tank bottoms and dome tops. This company's rubber drum, when used for the shipment of 60 per cent hydrofluoric acid, is being provided with a Neoprene lining and a new type of outlet with renewable metal threads. The company has developed a method for lining steel pipe and steel outlets with stoneware in which the stoneware sleeve is "floated" within a cast layer of Pyroflex.

A demonstration of the National Carbon Co., Cleveland, Ohio, showed many forms of this company's Kempruf carbon which is said now to have been developed to the point where it is completely impervious throughout. A bundle of heat exchanger tubes of this material, equipped with baffles and tube sheets, showed its possibilities for large equipment. Such equipment is assembled for heat exchanger manufacturers in lengths up to 6 ft. The heat transfer characteristics are said to be nearly equal to those of brass. Other demonstrations of this material included porous elements in new forms and two types of element now being used commercially in flue gas scrubbers.

National Lead Co., New York City, exhibited a new tellurium-lead alloy which it is claimed offers greater strength and better resistance to sulphuric acid than does ordinary chemical lead.

For rotary cross-feed kilns, a lining consisting of firebricks so shaped and fitted together that a series of recessed buckets is formed around the inside of the kiln, was shown by the Quigley Co., New York. The buckets are designed to give a more even distribution of falling particles of material through the path of the hot gas stream.

U. S. Stoneware Co., Akron, Ohio, showed a new four-way ceramic cock of the pressure lubricated type. Two new packing shapes were shown, including the Lessing ring which is stated not to have been made before in the United States; and a second shape closely resembling a W in cross section which is said to make possible the attainment of a high proportion of contacting surface per unit volume at relatively low cost.

More in January Issue

Sections of this report dealing with containers and packaging; materials and fluids handling equipment; and electrical and miscellaneous equipment, will appear in our January number.

Correction: In the description of the Ultra-Centrifuge made by the Sharples Specialty Co., Philadelphia, Pa., appearing on pp. 660-1 of our November number in the Chemical Exposition Preview section, an error occurred which may lead to a misunderstanding of the principles involved in this equipment. It was stated that the new machine is licensed under the Svedborg-Nickels patent for lower speed machines. This is incorrect. Although a license has been secured, the Sharples machine differs from the Svedborg in every particular except that a beam of light is transmitted through the sample for the purpose of observing it photographically, as in the Svedborg centrifuge. The Sharples machine is operated at speeds up to 80,000 r.p.m., giving a separating force equal to 250,000 times gravity. The Svedborg machine has been operated at speeds as high as 160,000 r.p.m., giving a force of 1,100,000 times gravity, but is more conservatively operated, as in the case of the machine used by the Du Pont company, at 60,000 r.p.m., giving a separating force approximately equal to that of the Sharples machine.

Process Equipment NEWS

Machinery, Materials and Products

New Adhesive

PHILADELPHIA QUARTZ Co., Philadelphia, Pa., has announced the recent development of a new modified silicate adhesive which was discovered in the process of manufacturing silicate-clay adhesives. This new material, "Stixso," is being used in the production of corrugated paper board. Later it is expected that other grades will be devised to meet the requirements of industries other than those making container board.

In this material the properties of the liquid and solid components have been so adjusted as to regulate accurately the degree of penetration of the adhesive into the paper surface. The adhesive remaining on the surface is said to set rapidly and stay where it has been put. Since the setting process is not a heat reaction, high speeds are said to be possible without extreme heat. According to the manufacturer the resulting product is a board of exceptional stiffness, free from warping.

Water Level Recorder

EXTREME accuracy in a water level recorder measuring only 6x8x12 in. overall and weighing but 10½ lb. is claimed for the new line of Model FW portable recorders recently announced by Julien P. Friez & Sons, Inc., Baltimore, Md. A 3- or 6-in. float operates the mechanism by means of a perforated stainless steel tape. The instrument records on a cylindrical chart and is provided with a cam guiding the pen arm which insures that equal increments of water height will always move the pen through the same chart distance. Two models are available, one in which the time lines are curved, and the other, with a pantograph movement to provide vertical pen movement, in which the time lines are straight.

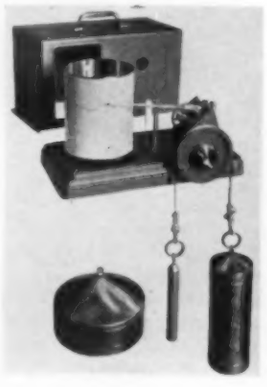
Vari-Speed Pulley

GREATER COMPACTNESS in its countershaft type of Vari-Speed motor pulley has been achieved by Reeves Pulley Co., Columbus, Ind., through the use of a new design of motor base and countershaft support. The base is provided with a handwheel control to move the motor forward or backward and thus vary the diameters of a set of adjustable disks forming the drive pulley which is mounted on the extension of the motor shaft. The accompanying illustration shows the new design in which the countershaft power take-off pulley is mounted in the center of the countershaft. This pulley may be replaced with a sprocket, pinion or V-belt sheave if desired. The new unit is available in sizes from fractional to 7½ hp., for speed ratios up to 3:1.

Medium-Speed Diesel

TYPE 8 is the designation for a new line of heavy-duty, medium-speed diesel engines supplied in models having from three to eight cylinders and in sizes from 90 to 300 hp., recently announced by the Chicago Pneumatic Tool Co., 6 East 44th St., New York City. An important feature of the new design is that these engines are convertible to the use of gas for fuel. The four sizes available all operate at speeds from 600 to 720 r.p.m. and are stated to have fuel economy equal to large, slow-speed diesels. All wearing parts are completely inclosed and positively and automatically lubricated. No part of the engines requires hand oiling or greasing. Instant starting is said to be assured by a simple starting valve which admits air to a cam-shaft-driven rotary distributor from which the air is distributed by piping to all cylinders.

New water level recorder

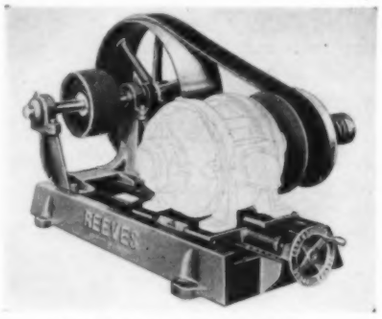


Equipment Briefs

A NEW self-contained, self-locking nut to which the name, "Unshako," has been given has been announced by the Standard Pressed Steel Co., Jenkintown, Pa. The nut is said to remain tight in spite of incessant vibration and jarring, yet to be capable of being backed off rapidly through the use of an ordinary wrench. It employs an integral self-locking ring or floating thread within the body of the nut which operates as a brake band.

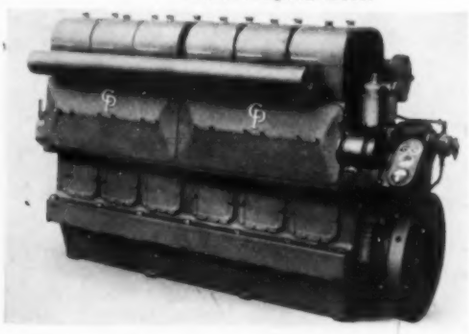
TWO NEW 2½ gal. fire extinguishers which are operated by the pressure of carbon dioxide gas against the surface of the extinguishing medium have been announced by the Pyrene Manufacturing Co., 560 Belmont Ave., Newark, N. J. One employs water as the extinguishing agent whereas the other uses water containing a special antifreeze chemical which prevents freezing of the solution at temperatures as low as —40 deg. F. In both types the CO_2 is contained in a cartridge within the extinguisher which is punctured to release the gas by inverting the extinguisher and striking a plunger against the floor. With both the range is approximately 50 ft. Neither type requires annual recharging as in the case of the soda-and-acid type.

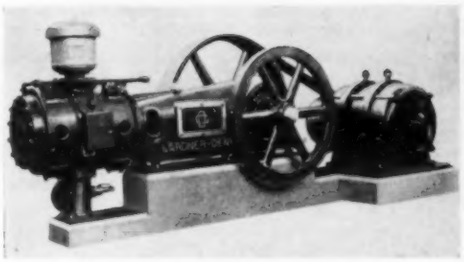
A NEW particle size analyzer for determining the size distribution of fine dry powdered materials has been announced by the American Instrument Co., Silver Spring, Md. This is the Roller analyzer which was described before the American Ceramic Society at



Variable-speed motor pulley

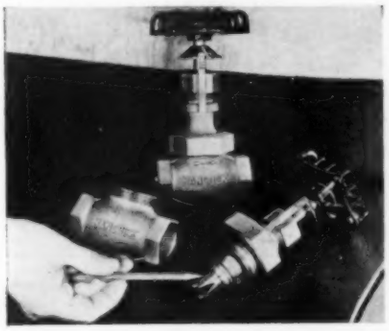
Medium-speed diesel





Single-stage compressor

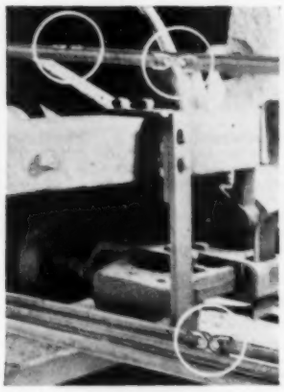
Parts of improved Flocontrol valve



its Spring, 1937, meeting. In use it can be operated to separate the sample into any desired number of size fractions, the smallest fraction conveniently secured being 0 to 5 or 0 to 3 microns, depending on the density of the material. Percentage weight of different fractions is said to be duplicatable to 0.5 per cent. The analyzer is recommended by the makers for use with most dry powdered materials finer than about 200 mesh and of size greater than colloidal.

LOCAL THICKNESS of an electroplated nickel coating on a non-magnetic base metal may be measured by a new instrument recently announced by the American Instrument Co., Silver Spring, Md. The instrument operates on the principle of measuring the force required to detach one pole of a permanent magnet from the nickel coating, and comparing this force with that required to detach the same magnet from a similar nickel coating of known thickness. Measurements made on coatings as deposited are correct within 15 per cent, and on annealed coatings, within 10 per cent, according to the manufacturers.

FOR MEASURING the wear resistance, toughness, adhesion and rub-off qualities of surface finishes, the Taber Instrument Co., North Tonawanda, N. Y., has developed a new device known as the Taber Abraser. The instrument is compact, portable and is claimed to give results comparable to years of wear within a few minutes. Specimens are tested under the action of wheels made of a resilient abrasive composition.



New V-belt fastener

Horizontal Air Compressor

AN IMPROVED single-stage horizontal air compressor for heavy-duty, full-load service and continuous operation at low power cost has been announced by the Gardner-Denver Co., Quincy, Ill., and given the designation RX. The new compressor is completely inclosed and dustproof but its working parts are said to be readily accessible. Exceptional freedom from vibration is claimed, while another important feature is the use of an improved control which always starts the compressor unloaded and adjusts the air supply to the requirements.

Redesigned Control Valve

COMPLETE REDESIGN of its line of Hancock bronze Flocontrol valves has been announced by the Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. The basic principle of straight-line flow characteristics employed in the original design of this valve has been retained but the valve seat and disks are now of superhard stainless steel of 500 Brinell hardness. It is stated that the seats and disks are so hard as to be able to smash nails, boiler scale and other hard substances without leaving a mark. These valves employ a new body design of the union bonnet type and are available at considerably lower prices than before. According to the manufacturers, they are used in maintaining closer manual control of steam-heated equipment of all sorts, for the control of gas and oil fuel and for the proportional mixing of liquids.

V-Belt Fastener

AFTER SEVERAL YEARS of successful tests, general distribution of a new fastener for joining "C" section V-belts of fabric-core, cross-weave construction has been announced by the Flexible Steel Lacing Co., Chicago, Ill. These new fasteners are said to make possible ready installation, shortening or replacement of V-belts on the job. Unique features of the new Alligator fastener include a double rocker arm pin supported in bronze bushings and a method of holding the end plate to the belt without materially weakening the belt or bulging its sides. The rocker pin is of special alloy steel and the design such that no metal touches the pulley. Directions for installation and special tools are available.

MANUFACTURERS' LATEST PUBLICATIONS

Air Filters. Independent Air Filter Co., 228 North La Salle St., Chicago, Ill. —Bulletin D-108—8 pages describing this company's continuous automatic self-cleaning non-clogging air filters of the impingement type.

Alloys. Haynes Stellite Co., Kokomo, Ind.—8-page booklet listing and briefly describing the "Haynes Stellite Library," a collection of 18 books, leaflets and folders, dealing with hard-facing alloys, cutting tools and alloys for chemical process equipment.

Alloys. Vanadium Corp. of America, 420 Lexington Ave., New York City—28-page book describing the use of vanadium in cast iron, with information regarding advantages, properties and uses; also 24-page book giving similar information on vanadium alloy steel for castings.

Apparatus. American Instrument Co., 8010 Georgia Ave., Silver Spring, Md.—Catalog 28-CM—100-page book on chemical and biological laboratory instruments offered by this company.

Apparatus. Bausch & Lomb Optical Co., Rochester, N .Y.—Catalog D-122—16-page book on dark-field optical systems in microscopy and ultra-microscopy.

Bearings. New Departure Division of General Motors Corp., Bristol, Conn.—Booklet D—20 pages discussing principles and applications of this company's N-D-Seal self-lubricated ball bearings.

Cements. Quigley Co., 56 West 45th St., New York City—Bulletin A.P. 122-R—8 pages describing and showing applications of this company's acidproof cements.

Chemicals. American Cyanamid & Chemical Corp., 30 Rockefeller Plaza, New York City—Two folders, one covering briefly this company's products for use in the textile industry and the other a similar treatment of resins, gums, nitrocellulose, plasticizers, solvents and other products for the manufacture of paints and other finishes.

Chemicals. The Barrett Co., 40 Rector St., New York City—4-page circular on safety in the use of benzol, describing the urine sulphate test, benzol properties and health hazards, and suggested ventilating means.

Chemicals. Hercules Powder Co., Wilmington, Del.—40-page book on this company's cellulose derivatives and chlorinated rubber, comparing the properties of the various basic raw materials as applied to industrial finishes for various purposes.

Chemicals. The Neville Co., Neville

Island, Pittsburgh, Pa.—Leaflet listing this company's coal tar products, including synthetic resins, solvents, plasticizing oils, oils and tar products.

Chemicals. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.—Data Book 2—12 pages on anhydrous and aqua ammonia, with information on effective handling, first aid and pertinent data.

Compressors. Ingersoll-Rand Co., 11 Broadway, New York City—Bulletin 3166—Describes this company's stationary, vertical, single-acting two-stage motorized air compressors, in sizes from 15 to 75 hp.

Equipment. Lukenweld, Inc., Coatesville, Pa.—Form 38AV-8 pages describing hydraulic presses of unique design, featuring a continuous welded frame designed and built by this company.

Equipment. Podbielniak Industrial Research & Engineering Laboratories, 222 East Superior St., Chicago, Ill.—Circulars 14, 15 and 16—Describe a variety of sizes of this company's centrifugal superfractionating and supercontracting equipment for laboratory and pilot plant use.

Fans. National Association of Fan Manufacturers, 5-208 General Motors Bldg., Detroit, Mich.—8-page bulletin covering standard methods adopted for centrifugal fans and blowers.

Feeders. Proportioneers, Inc., 9 Codding St., Providence, R. I.—Bulletin No. "Red"—10 pages on this company's chemical feeding equipment for water treatment and pH control.

Heat. Johns-Manville Corp., 22 East 40th St., New York City—48-page book describing in non-technical fashion the use and control of heat.

Heat Exchangers. Heat Exchange Institute, 90 West St., New York City—Recently published Standards of the Tubular Exchanger Section, covering mechanical construction and thermal standards for shell and bare tube heat exchangers; may be obtained at 75 cents per copy.

Heating. The Trane Co., La Crosse, Wis.—Publications as follows: Bulletin 284, 8 pages on this company's new projection unit heaters; Bulletin 294, 8 pages describing multiple projection unit heaters; Bulletin V-260, 36 pages on thermostatic and bucket steam traps and other heating specialties.

Heating Elements. Harold E. Trent Co., 618 North 54th St., Philadelphia, Pa. — Leaflet 30TE—Describes a variety of strip and immersion electric heaters, giving dimensions and prices.

Instruments. The Bristol Co., Waterbury, Conn.—Publications as follows: Bulletin 462, temperature controllers and recorders for furnaces, kilns, and industrial ovens; Bulletin 493, potentiometer pyrometer recorders and controllers; Bulletin 494, Bristol's new electric flowmeter.

Instruments. The Foxboro Co., Foxboro, Mass.—16-page folder illustrating and describing representative instruments of this company's line and explaining the significance of a seal of certification now attached to this company's instruments.

Instruments. Julien P. Friez & Sons, Baltimore, Md. — Bulletin K — Revised condensed catalog of this company's air conditioning products including a variety of control instruments, indicators and recorders.

Instruments. Emil Greiner Co., 55 Van Dam St., New York City—Bulletin 372—4 pages describing the Coleman Electrometer for pH measurement with the glass electrode; also Bulletin 371, 20-page article describing the measurement of pH with the glass electrode, giving detailed information.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Catalog N-33-163—32 pages on this company's temperature measuring and recording equipment for the power plant; also leaflet describing the use of the Rayotube pyrometer in controlling the revivifying of filtering clay.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Bulletin 1125B—24-pages on this company's complete line of industrial thermometers; covers also miscellaneous thermometers, hydrometers, U-gages and barometers; also price list on industrial thermometers.

Instruments. Thwing-Albert Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.—Leaflet describing this company's "Treasure Chest," a portable potentiometer for pyrometer checking.

Insulation. Continental-Diamond Fibre Co., Newark, Del.—20 pages on properties, specifications and uses of this company's Micabond built-up mica insulation.

Insulation. Johns-Manville Corp., 22 East 40th St., New York City—Form IM-55A—32 pages covering this company's various types of insulation and insulating brick with specific recommendations for insulation of many types of industrial equipment; also Form GI-6A—62 pages covering this company's industrial products such as insulation, roofing and siding materials, friction material and pressure piping.

Insulation. Keasbey & Mattison Co., Ambler, Pa.—A general catalog covering this company's magnesia and asbestos products in 10 general classifications.

Jets. Croll-Reynolds Co., 17 John St., New York City—Catalog 103—14 pages describing types, construction, uses and performance of this company's steam jet ejectors and thermo-compressors.

Jets. Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin W-205-B6—Bulletin covering this company's improved single-stage steam jet ejectors, with information on construction, sizes and typical applications.

Lighting. Westinghouse Electric & Mfg. Co., Cleveland, Ohio—Catalog Section 61-166—Leaflet describing the Millite lighting unit for extreme conditions in industrial plants.

Lubrication. Bijur Lubricating Corp., Long Island City, N. Y.—Bulletin F—Folder briefly describing this company's lubricant distribution system for machinery.

Lubrication. E. F. Houghton & Co., Third, American and Somerset Sts., Philadelphia, Pa.—16-page book on this company's Sta-Put lubricants, their properties, types and uses.

Materials Handling. Cleveland Crane & Engineering Co., Wickliffe, Ohio—6-page folder describing a variety of planned material handling systems fitted with this company's equipment.

Materials Handling. B. F. Goodrich Co., Akron, Ohio—30-page book, with data, describing rubber tires and rubber-tired wheels for industrial materials handling equipment.

Materials Handling. Link Belt Co., 220 South Belmont Ave., Indianapolis, Ind. —Folder 1651—6 pages describing No. 4250 swivel chain and sprockets for conveying. This chain will travel around curves.

Metal Spraying. Metalspray Co., 113 Llewellyn St., Los Angeles, Calif.—Bulletin 800—4 pages describing a variety of applications of metal spraying.

Mixers. Lancaster Iron Works, Lancaster, Pa.—Bulletin 70-B—50 pages on this company's mixers, giving detailed specifications and dimensions.

Motors. Century Electric Co., St. Louis, Mo.—24-page book presenting factual information on characteristics and selection of fractional horsepower motors of all types.

Nickel Alloys. International Nickel Co., Inc., 67 Wall St., New York City—Bulletin T-14—24 pages of technical information on the design and construction of heavy equipment in Monel, nickel and Inconel; also 8-page index of current publications dealing with nickel alloy steels and cast irons, nickel brasses and bronzes, and other nickel alloys.

Packaging. Acme Steel Co., Chicago, Ill.—"My Second Scrapbook," by Doc Steelstrap, a 16-page book on the use of steelstrapping in the shipping of a large variety of products.

Paints. Aluminum Co. of America, Pittsburgh, Pa.—Form AD123—102-page book on aluminum paint, covering characteristics, pigments, vehicles, testing, application and use.

Paints. Pennsylvania Salt Mfg. Co., 1000 Widener Bldg., Philadelphia, Pa.—Leaflet describing Pennpaint, this company's new chlorinated rubber-base paint for resistance to acids and many alkalis.

Power Generation. DeLaval Steam Turbine Co., Trenton, N. J.—12-page brochure illustrating and briefly describing a variety of turbine installations made by this company.

Power Transmission. Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., Passaic, N. J.—4-page bulletin describing this company's Condor compensated belts for power transmission.

Pumps. Dayton-Dowd Co., Quincy, Ill.—Bulletin 805—16-page book describing and giving engineering data on this company's new type DC close-coupled centrifugal pumps.

Pumps. DeLaval Steam Turbine Co., Trenton, N. J.—Bulletin L-32-10—8 pages describing and showing installations of this company's IMO rotary oil pumps.

Pumps. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 260-B14B—6 pages describing an automatic condensate return unit for boiler supply, equipped with this company's turbine pump.

Refractories. Harbison-Walker Refractories Co., Pittsburgh, Pa.—296-page second edition of this company's book, "Modern Refractory Practice," with 52 illustrations, 97 charts and tables, and index. Covers every phase of the subject of industrial furnace refractories. Handsomely printed and bound in stiff covers. Intended to serve as a practical service handbook with much general information in addition to specific information in regard to this company's products. Includes 16 full-page furnace drawings prepared on the basis of current industrial practice, in cooperation with engineers specializing in furnace designs. Gives information on selection, care and use of refractories, on ordering and handling of brick, bonding methods and all phases of design. Basic technical data on composition, structure and properties of refractories as affected by furnace temperatures, furnace gases, and slags, are included, as well as tables and formulas for calculating brickwork. Book is offered without charge to refractory users, and at $2.50 per copy to others. For students and faculty members, price is $1.25 for single copies and $1 in lots of six or more.

Refractories. Norton Co., Worcester, Mass.—Form 803—24 pages on heavy duty refractories of fused alumina and silicon carbide; also 16-page bulletin on this company's fused alumina porous mediums.

Refractories. Quigley Co., 56 West 45th St., New York City—Leaflet showing thermal properties of this company's various grades of Insulbrix insulating firebrick.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS ELECTS OFFICERS

One of the largest and most successful meetings of the American Institute of Chemical Engineers ever held in the Middlewest attracted approximately 400 chemical engineers and their guests to St. Louis during the week of November 15. Two days were given over to a student program in which more than 175 members of the student chapters participated in plant visits and interesting round-table discussions of the professional work and development of the younger chemical engineer. Past-President A. E. Marshall, Dr. Harry A. Curtis, chief chemical engineer of T.V.A., Dr. C. A. Thomas of Dayton, and many local leaders of the profession assisted in the direction of a highly interesting program.

Gaston DuBois, vice-president, in charge of research and development, Monsanto Chemical Co., officially welcomed the 30th annual meeting to St. Louis. He spoke on behalf of and paid a fine tribute to Dr. F. W. Frerichs, the honorary chairman of the General Committee, who is one of the founders and for many years was a most active member of the Institute. He came to St. Louis 57 years ago—the first Ph.D. in chemistry to settle in the St. Louis area. His son, F. W. Frerichs, Jr. and his daughter, Miss Hildegarde Frerichs, played important parts in the work of the committee on arrangements.

Stephen L. Tyler, Executive Secretary of the Institute reported that the total membership is now 1,637 as compared with 1,437 a year ago. Approximately 70 per cent are active members, 6.8 associates and 23.5 are juniors. The latter has shown an increase of 43.1 per cent during the past year.

Professor Joseph C. Elgin, Chairman of the Committee on Student Chapters, reported that there are now 53 active chapters and two additional ones are under consideration. He estimates the total number of student members at 3,500 with as many as 6,000 regularly participating in their scheduled meetings.

H. E. Wiedemann, president of the local chapter and vice-chairman of the general committee, reported for the Board of Tellers that the following officers had been elected for 1938: President, Frederick Clemens Zeisberg of the Development Department of the duPont company, Wilmington, Del.; vice-president, Webster N. Jones, Director, College of Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.; secretary and executive secretary, Stephen L. Tyler of New York City; and treasurer, Carl R. DeLong, Consulting Chemical Engineer of New York City. The following were elected directors for the three-year period: Lawrence W. Bass, Assistant Director, Mellon Institute of Industrial Research, Pittsburgh, Harry A. Curtis, Chief Chemical Engineer, Tennessee Valley Authority, Knoxville, Tenn., Francis C. Frary, Director of Research, Aluminum Co. of America, Pittsburgh, and Ellery L. Wilson, Vice-President, Rumford Chemical Co., Providence, R. I.

Symposium on Drying and Air Conditioning

Eleven technical papers on drying and air conditioning, and a round table discussion of drying equipment participated in by manufacturers' representatives of nine different types of dryers, are the principal features of the Fourth Chemical Engineering Symposium of the Division of Industrial and Engineering Chemistry, to be held at the University of Pennsylvania, Philadelphia, on December 27 and 28. This symposium on drying and air conditioning follows symposia on distillation, heat transmission, and absorption and extraction, held at this same time for three previous years.

The program will open with a paper discussing the fundamentals of drying and air conditioning, to provide a theoretical background for the technical papers which follow. There will be several papers reporting research on the mechanism of evaporation of water into air, a description of an equilibrium pressure chart, and a method for the accurate determination of dew point. Drying agents will be discussed in papers on drying with activated alumina, and with lithium chloride. Papers will be presented on vacuum drying, and on spray drying. The round table discussion of drying equipment will deal with rotary dryers, rotary louvre dryers, steam tube dryers, spray dryers, vertical turbo dryers, crystal filter dryers, drum dryers, aeroform dryers, and agitator dryers.

Social features of the meeting will be group luncheons on both days, and a dinner program on December 27. The principal feature of this evening program will be a talk on "Research and Development in Television" by a recognized authority in this field. Local arrangements are under the direction of Prof. N. W. Krase, of the University of Pennsylvania.

Stainless Steal Exhibit at Rockefeller Center

An exposition of stainless steel has just opened for a period of several months in the New York Museum of Science and Industry, RCA Building, Rockefeller Center, New York. This exhibit, which is sponsored jointly by Electro Metallurgical Co., unit of Union Carbide and Carbon Corp., and the Museum, will be open every day and evening.

Every aspect of stainless steel—its history, development, production, fabrication, and uses—is portrayed in a comprehensive and educational manner. The display includes hundreds of stainless steel products sent to the exhibit by manufacturers from all over the United States. The fields of application receiving especial emphasis are the household, the food and beverage industries, general industry, transportation, architecture, and the medical and dental professions.

The displays of stainless steel products are supplemented by motion pictures and demonstrations showing why stainless steel is an important contribution to mankind, its usefulness in the food industry, its adaptability for strong, lightweight structures and for high-temperature service, and its importance in architectural applications. Every step in the production of this important alloy is illustrated.

Germany Improves Sulphate Of Ammonia Production

The American Consulate General at Frankfort-on-Main reports that Germany has finally succeeded in developing a new process which enables the utilization, in one continuous operation, of the hydrogen suphide of coke-oven gas for binding the ammonia gas to ammonia sulphate. It is estimated that, based upon present levels of coke-oven activity, the new process, known under the name "Katasulf", can enable a saving of some 110,000 metric tons of sulphur in the form of iron pyrites imported from abroad and now required for producing some 400,000 to 450,000 metric tons of 60° sulphuric acid used for converting the ammonia-gas to ammonium sulphate. However, it would appear that, for the present at least, the new process will not justify the conversion of existing coke-ovens to its use, owing to the considerable costs thus involved, but probably the process will assume more importance in the case of entirely new plants. The first plant utilizing the new "Katasulf" process, with capacity of 30,000 to 35,000 cubic meters of gas per hour, has already been constructed and is now in operation in the Ruhr district.

It is stated that aside from reducing the need for imported pyrites for producing sulphuric acid for manufacturing ammonium sulphate, the new process also enables a reduction of around 10 per cent in production costs of ammonium sulphate compared with customary methods now employed of using sulphuric acid. Moreover, the ammonium sulphate output is improved, because some of the cyanogen compounds present are converted to ammonia and carbon dioxide. Furthermore, owing to the freedom from sulphur of the gases it is possible to slow down the wash-oil concentration in washing out the benzol, so that the benzol wash-oil can be used three times as long as in the case of non-desulphurized gases.

Louisiana Engineers Will Meet at New Orleans

The annual meeting of the Louisiana Engineering Society will be held at the St. Charles Hotel, New Orleans, on Jan. 7–8. On the morning of Jan. 7, sectional meetings will be held after the keynote address of J. Frank Coleman, consulting engineer of New Orleans. In the afternoon an inspection trip will be taken to the power plant of the New Orleans Public Service, Inc. In the evening, Joseph B. Strauss, designer and builder of the Golden Gate Bridge, will deliver an address.

On the morning Jan. 8, a paper by K. P. Kammer and G. L. Rhodes will be read on the subject of "The Design and Installation of an 850 lb.—900 deg. F. Boiler-Turbine Unit of 37,500 kva Capacity." James M. Todd also will read a paper on "Registration of Engineers in Louisiana." In the afternoon, M. J. Rathbone, president of the Standard Oil Co. of Louisiana will speak on "Oil Conservation from a Refiner's Viewpoint." The annual dinner will be held in the evening.

Penn Salt Will Build Chlorate Plant

Announcement has been made by Leonard T. Beale, president of the Pennsylvania Salt Mfg. Co. of Philadelphia, that his company has acquired a site near Bonneville Dam in Oregon and will start construction of a plant for the manufacture of chlorate of soda. The Chipman Chemical Co., Bound Brook, N. J., will handle the distribution of the product.

Continental United States Potash Deliveries

The American Potash Institute has announced that potash deliveries within the continental United States, Canada, Cuba, Puerto Rico and Hawaii during the third quarter of the calender year 1937 amounted to 150,026 tons of actual K_2O. This was equivalent to 280,348 tons of potash salts. Constituting this total were 216,188 tons of muriate, 14,261 tons of manure salts, 25,190 tons of sulphate, 17,143 tons of kainit and 7,566 tons of sulphate of potash magnesia. These figures include salts of domestic and foreign origin, exclusive of importations of potassium nitrate.

Chemicals and Explosives Purchased by W.P.A.

Chemicals and explosives valued at $6,250,454 were among the nearly one-half billion dollars worth of materials, supplies and equipment purchased for projects of the Works Progress Administration in the first 26 months of its operation up to Sept. 1, 1937, according to records of the WPA Division of Research, Statistics and Records.

Of this amount, $3,490,696 was in Federal funds from various emergency relief appropriations, and $2,759,758 was in funds of the sponsors of projects.

Construction or repair accounted for 80 per cent of all the WPA activities. Road building, in some cases, required continuous blasting to provide rights of way; explosives were used to check mine fires in Ohio; chemicals were freely used in the wars on insect and rodent pests.

International Chemical Congress at Rome

The Tenth International Congress of Chemistry will be held at Rome on May 15-21, 1938. Chemists and scientists from all parts of the world are expected to attend. Technical sessions will be held in the buildings of Rome's new "University City."

The program is divided into 11 sections, each dealing with some phase of chemical activity, including chemical training, patents, basic chemical products, fuel technology, chemistry in the food industry, in the home, in textiles, in training, in photography, in agriculture, in land, air and sea navigation, and in warfare.

Norman E. Diehl (left) of E. I. duPont de Nemours & Co., Inc., receiving first prize award of $250 from Charles F. Roth, manager of the Exposition of Chemical Industries. Mr. Diehl's slogan "Chemical Research Creates Industries" was selected as the best in a competition to create a brief descriptive expression encompassing the aims and the benefits redounding to men from the activities of the chemical industries.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

CONGRESS would like to do something for business. The President does not object, if—if it does not interfere with his reform plans. And even if it does so interfere, the President will not try to prevent Congress from doing something, that is, something not too anti-reform in type.

Under these circumstances, Congress will not make much progress on the business legislation, probably nothing at all in time to wrap up a law as a Christmas present. When it reconvenes, with New Year's resolutions in mind, it may do a little better. But even the tax revision greetings which are planned by Congressmen will probably reach business men much too late to affect any dividend policy this year.

New Laws Expected

In its tax revision program, Congress needs facts from industry clearly to prove well-established impressions as to the business consequence of present laws. Amendments to undistributed-profit and capital-gains taxes will be more favorable to business if representatives of any district are given specific examples, which they may cite in committee and on the floor of Congress, as to where new business would develop or more employment would follow in their home communities.

Appreciation that the current level of business activity is lower than expected makes any new wage-and-hour regulation rather unlikely, or innocuous in prospect. To save the face of the Administration, and of Congressmen from labor districts, some kind of a bill may be enacted. But this will not be a rigid set of wage-and-hour standards as planned six months ago. Also the chance of drastic reorganization of the Government, or extension of the T.V.A. system of planning, have been virtually abandoned in fact, if not publicly.

New effort in anti-trust regulation seems to be fizzling out. Administration critics say that recent verbal grenades form a harmless smokescreen, that there is no poison gas for honest business in any of them. Large industry is, however, being warned to keep its gas mask at "alert".

However much some taxes are cut, it is not expected that the President will consent without a bitter fight to any legislation that adds new burdens on the Treasury or much reduces the total bill which Uncle Sam will send to business on next March 15. The greatest advantage in sight for those economy-minded is the willingness of the Administration to ask definitely for curtailed spending on roads, other public works, and sharp limitation on farm benefit payments. But critical observers continue to say "the President can be pushed." And the pressure groups in Washington willing to push are all too evident.

Congress asked the Secretary of Agriculture to report to it on the alarming series of deaths which followed the unfortunate distribution of sulfanilimide "elixir". The report made November 25 tells of the admirable effectiveness with which the Food and Drug Administration traced and removed from distribution the dangerous drug which had been sent out over 15 states. And the report, apparently justifiably, points out that this effort kept below 100 the deaths which might have been many times this number with unrestricted distribution.

Drug Licensing Urged

In conclusion of the report, the Secretary makes several recommendations for legislation, the first and most important of which is that Congress provide "license control of new drugs to ensure that they will not be generally distributed until experimental and clinical tests have shown them to be safe for use."

It is expected that this new and radical extension of authority will be urged as a part of the Copeland food and drug bill which is still pending in the House committee. Insistence on such enlarged authority may provide a new controversial basis to delay enactment of this bill into law, friends of the measure fear. If this new controversy does not develop acutely, there is fair chance that a new Food and Drug Law may be enacted during the regular session beginning in January.

Tariff Cuts Planned

Renewed impetus has been given to tariff adjustment by the announcement of plans to negotiate reciprocal agreements with the United Kingdom and with Canada, the latter a revision of an existing pact. Washington expects some fundamental adjustments of large industrial importance to come out of these British Empire deals. In fact, they represent a far more important series of negotiations than all the preceding combined.

Lists of commodities to be considered in Czech and Ecuador discussions have been available for some time, but up to December 1 the State Department had not announced what commodities would be considered for Canadian, British, Venezuelan or Turkish discussions.

New Sanctions Idea

A new plan of commodity sanctions is said to be a part of this trade agreements program. One civilian official in Washington likens proposed pressure on aggressor nations to jiu jitsu. Such withholding of raw material supplies would be very effective, if the English-speaking nations could find just the right spot and press just hard enough. Withholding of mineral raw materials is proposed as basic to this plan, but other commodities of chemical-industry interest will certainly be drawn into the discussion, if these negotiations do not break down quite soon.

Failure of sanctions in the Italo-Ethiopean incident is blamed on inadequate planning and incomplete cooperation of industry. Cutting off aluminum supplies is characterized as silly, as Italy was quite self-sufficient in this regard. And the breakdown of petroleum control was "inevitable", since Rumanian commercial cooperation was not secured. Preliminary studies are said to indicate that only by cordial British-American cooperation, including both government and industry, would it be feasible to make a mineral sanction plan workable. And then the availability of the combined British and American navies, ready to act if need be, is presumed as necessary for enforcement of restrictions.

Washington does not expect sanction agreements to be a published part of the reciprocal trade agreement, but exploration of this area "is encouraging" to those who feel that former neutrality efforts were ill-conceived, perhaps even worse than nothing in the Orient.

Latin American Threats

American enterprises in Mexico are being severely restricted with respect to the right of developing underground resources. Communications from the State Department to President Cardenas about the seizure of certain petroleum lands and other mineral properties are said to have been couched in language much stronger than that commonly called diplomatic.

Brazil's abrupt change in its government form also threatens American interests in that country, Washington fears. Certainly neither legislative nor judicial restrictions on dictatorship continue in the old form under the constitution promulgated by the President recently.

GERMANY MAKES PROGRESS IN SEARCH FOR NEW RAW MATERIALS

From Our German Correspondent

GERMANY'S economic difficulties in the search for new raw materials, have brought the chemical industry into the limelight, and it does not seem an overstatement to say that along with the metallurgical industry it is the most important industry in Germany today. Not only industrialists and scientists, but the whole population is actively interested and is following every new development, and as a result of concentrated effort, developments that might otherwise have taken years are now being greatly accelerated. Not much more than 50 years old, the chemical industry, whose annual production exceeds 6 billion RM, accounts for 10 per cent of Germany's industrial production. The degree of rationalization attained in this production is evidenced by the fact that only 3 to 4 per cent of Germany's workers is employed in the chemical industry. Whereas the use of power in all German industry has been multiplied by 28 since 1875, in the chemical industry the increase has been 90-fold.

In the textile field Germany's chemists are experimenting successfully not only with staple fibre (called "cell wool," for admixture with cotton or wool), but are now producing a new fibre, "Kotonin." Also called "flax-" or "hemp-wool," this fibre is being made from chemically treated hemp or low-grade flax and is characterized by its great strength and durability. The attempts to use domestic fibres in place of imported bast fibres, jute, sisal, and manila, are going ahead, and a special staple fibre is being developed for the jute industry. Promising experiments have been made using straw, broom, willow bark, and reed grass, to make a fibre that can be mixed with others as a basis for a satisfactory cloth.

Glass is used, although not too successfully so far, as a spinning material, especially in the jute industry. Since it does not require imported raw materials, glass wool is used in increasing quantities as insulating material to replace cork and asbestos. Similarly, glass is "exchanged" for imported metals, and more recently, as a substitute for domestic synthetic resins. Germany is now following America in finding new uses for glass. Glass pipes are being installed in breweries, creameries, and refrigeration plants in place of copper and tin, and in one of Berlin's largest restaurants, over 600 feet of glass beer pipes have been installed, and it is reported that this arrangement is more satisfactory than the former metal pipe. Glass cooling coils are used in ice boxes, water heaters, and in chemical apparatus and automobile batteries in the place of rubber. Specialist "glass plumbers" are trained by the factories to overcome the difficulty of finding skilled workmen to install this equipment. The use of glass instead of tin for packaged products is encouraged, partly through forbidding the use of tin cans for certain purposes. Contrary to practise in America, deposits are required to secure the return of glass, even for preserve jars, and it is estimated that if the glass jar can be used six times, this will cancel the higher cost of packing, freight, and rubber ring seals, and make its use as economical as the tin can. Through careful handling, German dairies report that each milk bottle is used on the average from 40 to 50 times.

The glass works of the "Torgauer Glashütten A. G.," Torgau on the Elbe, which have been shut down since 1932, are being taken over by the German Libby-Owens glass company, and it is planned to resume operations soon. This plant will manufacture window and heavy glass for export only.

A plant for regenerating old rubber will be erected in Hamburg-Billbrook at the beginning of the year. It is reported that it will use a process whereby the fabric parts contained in the old rubber will not be destroyed. The new synthetic rubber, "Buna," cannot be regenerated, however.

An experimental company for shark and high-sea fishery has been established in Hamburg by an Offenbach leather manufacturer to increase production of leather from fish caught by German fishing boats, with fish meal and shark train-oil (blubber) as byproducts. By the end of the year the company's chartered fleet consisting of a central production ship and four auxiliary fishing boats will sail from Hamburg for West Indian waters.

In Bramberg, Austria, an America-Austrian concern has resumed beryllium mining operations, and plans to refine the ore. Beryllium, has been used, almost solely as an alloy because of difficulty in working the metal. The fact that purer beryllium metal is softer than preparations containing slight impurities, however, gives hope that it will soon be ductile enough to be generally workable in sheets. In fact, experimentally, according to a special process in the laboratories of the German "Gold- und Silberscheideanstalt," Frankfurt, it has been possible to form pure beryllium into small plates, sheets, and hollow and solid cylinders. The pieces have a high mechanical constancy and can be worked on the lathe or can be ground and filed, and will take a high polish. Small beryllium washers of 14 mm. diameter and 1 mm. thickness by the Brinnel test showed a hardness of 70, the same degree as in the compact molten metal. It is used increasingly in X-ray and medical apparatus, and has considerable possibilities for use in radiology, electron physics, and atom research.

With the growing importance of aluminum, especially in Germany, the recent death of the German chemist and metallurgist, Dr. Alfred Wilm, has attracted special notice. Wilm is best known for his invention of "Duralumin." Today "Duralumin" still contains practically the same amounts of the various elements, aluminum, copper, magnesium, manganese, silicon, and iron, as in his first patent in 1909. Wilm also contributed greatly to the development of thermite welding.

A new aluminum container, which has an inner and outer coating of a mechanical and chemical resistant lacquer, has been placed on the market. These flasks can be used for transporting a number of liquid chemicals which corrode unprotected aluminum and other metals. The lacquer is elastic and tough enough not to crack when the flasks are subjected to hard blows or are dented. Experience with these seamless aluminum containers shows that, aside from the advantageous weight, they are resistant to a number of liquids, including acetone, acetyl cellulose and nitro-cellulose lacquers, ether, alcohol, amyl acetate, benzol, lead acetate, butyl acetate, chloroform, acetic acid, formaldehyde, liquid soap, carbon tetrachloride, etc. Its resistance to other chemicals is now being investigated by the Karlsruhe state testing institute.

CALENDAR

INTERNATIONAL HEATING AND VENTILATING EXPOSITION, Grand Central Palace, New York City, January 24-28, 1938.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, annual meeting, New York City, February 21-24, 1938.

AMERICAN CERAMIC SOCIETY, New Orleans, La., March 27-April 2, 1938.

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Dallas, Texas, April 18-21, 1938.

ELECTROCHEMICAL SOCIETY, Savannah, Ga., April 27-30, 1938.

PERSONALITIES

Vladimir Ipatieff Honored

ON THE evening of November 26 a thousand distinguished leaders in science, business and education gathered together at a banquet in Chicago to pay honor to Dr. Vladimir N. Ipatieff, long esteemed as one of the world's greatest chemists. The occasion was his seventieth birthday, and the host was the Chicago section of the American Chemical Society.

Dr. Ipatieff's chemical discoveries have laid the foundation for many industrial processes and chemical engineering developments, particularly in the refining of petroleum and synthesis of hydrocarbons. In high pressure work such as the hydrogenation of organic compounds, he was one of the outstanding pioneers. His more recent work has been concerned with the effect of

Vladimir N. Ipatieff

catalysis on the decomposition of organic molecules and the polymerization of olefins.

Although now an American citizen, Dr. Ipatieff was born in Russia and spent most of his life in that country. During the World War he was at the head of all chemical activities of the Russian government. Following the Russian revolution he became president of the Central Chemical Bureau and in 1927 founded the Institute of High Pressure Research at Leningrad.

A long cherished desire to visit the United States was realized in 1930 when he came to this country at the invitation of the Universal Oil Products Co., a step which culminated in his joining that company and establishing permanent residence in Chicago. At present Dr. Ipatieff is director of chemical research for Universal Oil Products and professor of chemistry at Northwestern University.

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✦ T. G. BATCHELOR has been appointed resident manager of the Freeman, Ont., plant of Papermakers' Chemical Corp. Ltd. He succeeds the late J. Hibbs and will be manager of manufacture and sales of resin sizing.

✦ H. J. CREIGHTON of Swarthmore College is to be credited with the original development of the electrolytic process for the reduction of sugars to polyhydric alcohols. This process is now being carried out commercially by the Atlas Powder Co. and was described in *Chem. & Met.'s* October article entitled "Sorbitol From Glucose by Electrolytic Reduction."

✦ DONALD NIEMEYER, formerly chemical engineer for the Munising Paper Co., has joined the staff of the Institute of Paper Chemistry at Appelton, Wis.

✦ J. H. SHERTS has been appointed technical administrator of the newly created central research and development division of the Pittsburgh Plate Glass Co. This position, along with the chairmanship of the research directors committee, will place Mr. Sherts at the head of the general research program for the entire company. He will discontinue his duties as superintendent of the company's Duplate factory at Creighton, Pa.

✦ L. W. WALLACE has been appointed head of the Crane Co.'s newly formed division of engineering and research.

Dexter North

✦ DEXTER NORTH, who has served for several years as chief of the chemicals division, U. S. Tariff Commission, has resigned from government service to become associated with Arthur D. Little, Inc., as its Washington technical representative. He is planning to make both economic and technical studies in the chemical field.

✦ C. A. ROSE, formerly consulting metallurgical engineer for Cyprus Mines Corp., has joined the staff of the Dorr Co.'s Westport Mill in the capacity of consultant.

✦ LLOYD J. EDGERLY, chemical engineering graduate of the University of the Maine and lately assistant to the manager of the New England incandescent lamp division of the General Electric Co., died on Nov. 1 at Swampscott, Mass. He was 41 years old.

✦ FREDERICK WILLIAM FREISE, service manager for the American Cyanamid Co., died November 10 at Salisbury, N. C. Mr. Freise spent his entire life in the fertilizer industry and has been associated at one time or another with the American Agricultural Chemical Co., Swift & Co. Fertilizer Works, and the Wilson-Martin Co. of Philadelphia. He joined American Cyanamid in 1922.

Chemical ECONOMICS and MARKETS

MANUFACTURING ACTIVITIES CONTINUE ALONG RESTRICTED LINES

REPORTS of activities in manufacturing industries indicate that production schedules have been on a declining scale. The combined index for manufactures as compiled by the Federal Reserve Board stood at 122 for March, April, and May of this year and it is expected that the number for November will stand around 93 which gives a fairly accurate picture of the degree of recession in production activities from June to date.

The rapid rate of decline in some of the industries, such as iron and steel, has accentuated the downward curve and while the output of chemicals has been affected adversely by the trend of manufacture in general, its rate of decline has been considerably less than that reported for all manufacturing industry. In some instances, notably mineral oil refining, consumption of chemicals has held a fairly even course and on a plane higher than that reached last year.

Important consuming industries, however, such as textiles, have fallen far below the production rate reached in the first half of the year with a corresponding effect on the volume of chemical consumption. Rayon, which has been establishing new records for production each year, will again make a new record but November production fell off to such an extent that total output for the year will not come up to the estimates made a few months ago.

Manufacturers sales showed a gain of slightly more than 3 per cent during October, as compared with October, 1936, while the rate of collections on accounts receivable decreased, according to reports from manufacturers cooperating in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce.

Without adjustment for seasonal influences, October sales fell off about 5 per cent from September, the rate of collections being fractionally lower than last month.

Wide variation between industry groups was manifest in comparing October sales with October, 1936, the rubber products and machinery groups standing out with increases of 29 per cent and 26½ per cent respectively. In all, eight of the industry groups separately shown reported increases. The remaining six groups reported sales down from last October, ranging from a decrease of 4 per cent recorded by the iron and steel products industry to a decrease of about 15 per cent for stone, clay and glass products industry.

Manufacturers sales of chemicals and allied products were 1.1 per cent higher than those for the preceding month and 7.4 per cent above those for October last year. Paint and varnish sales were 11.2 lower than in September and 6.2 per cent below the October total.

Business prospects have been helped materially by the promise of housing, utility and railroad spending. Another encouraging sign is sustained volume of retail buying. November department stores sales will be only slightly less than in 1936, preliminary reports show. Trade is so much better than production that visible supplies of consumer goods are shrinking faster than had been anticipated. The present situation, however, emphasizes again the great need for more adequate statistics covering stocks, orders and inquiries. Production statistics cover the field fairly well. Enough figures are available to indicate fairly clearly the volume of retail sales but there is a great dearth of information in between upon which prospective production can be estimated. Inventories in some lines of consumer goods are known to be so low that buying cannot be deferred much longer.

Consumption of cotton which ran considerably above the 1936 rate in the early part of this year has now fallen to a point where practically all the early gains have been wiped out and the outlook is that the textile industry as a whole—not including rayon—will be about the same as it was a year ago with reference to consumption of chemicals.

The glass industry, largely because of container production which accounts for about one-half of total glass production, still holds a fair gain over last year despite recent cuts in manufacture which have brought plate production below last year levels.

Synthetic methanol is another chemical which has run counter to the general trend. Production in October was reported at 3,532,091 gal.—higher than for any previous month in the history of the industry—and for the ten months ended Oct. 31, production was 24,363,933 gal. compared with 20,136,035 gal. for the corresponding period of last year and with 25,563,742 gal. for all of last year. Less than seasonal gain was reported for crude methanol production in October, the total being 423,792 gal. which compares with 511,541 gal. produced in October 1936. For the ten months production was 4,868,741 gal. and 4,505,334 gal. for 1937 and 1936 respectively.

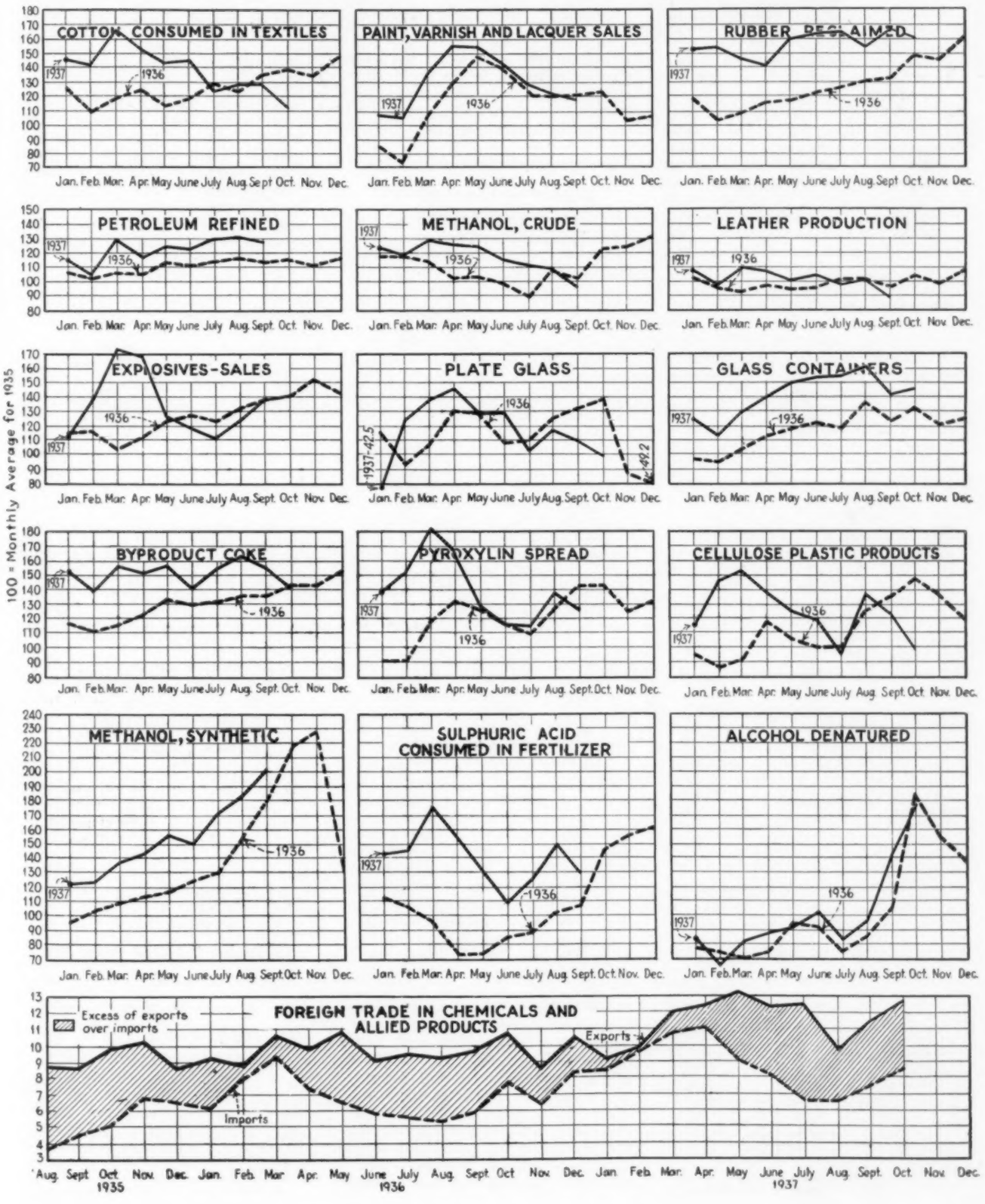
Automotive output in October was higher than in the corresponding month of last year but in the two final months of 1936, production totaled 893,697 units which is a much larger figure than will be reached in the two final months of this year.

Production and Consumption Data for Chemical-Consuming Industries

	Oct., 1937	Oct., 1936	Jan.-Oct., 1937	Jan.-Oct., 1936	Gain for 1937 per cent
PRODUCTION					
Alcohol, ethyl, 1,000 pr. gal	18,786	22,087	179,903	156,820	14.7
Alcohol, denatured, 1,000 wi. gal	14,369	15,073	82,266	75,615	8.8
Automobiles, 1,000	330	225	4,123	3,560	15.8
Benzol, 1,000 gal	9,610	9,729	103,202	85,077	21.3
Byproduct coke, 1,000 tons	4,036	4,077	43,151	36,160	19.3
Ammonia, tons[1]	62,806	63,422	683,466	563,533	21.3
Cellulose acetate plastics, 1,000 lb	919	1,462	11,828	10,343	14.3
Nitrocellulose plastics, 1,000 lb	1,283	1,806	16,053	13,941	15.2
Glass containers, 1,000 gr	4,417	4,250	45,695	37,303	22.5
Plate glass, 1,000 sq. ft	14,855	20,843	171,154	177,615	*3.6
Methanol, crude, 1,000 gal	424	512	4,869	4,505	8.1
Methanol, synthetic, 1,000 gal	3,532	3,278	24,364	20,136	21.0
Rosin, wood, bbl	64,976	57,809	632,368	545,763	15.9
Turpentine, wood, bbl	10,467	8,731	98,437	86,370	14.0
Rubber reclaimed, tons	15,849	13,898	154,297	119,437	29.2
Steel barrels, heavy, 1,000	939	923	8,464	6,971	21.4
Steel barrels, light, 1,000	139	190	1,645	1,572	4.6
CONSUMPTION					
Cotton, 1,000 bales	526	651	6,505	5,782	10.2
Silk, bales	36,002	43,093	371,568	372,612	*0.3
Explosives, sales, 1,000 lb	34,810	36,472	329,395	305,853	7.7
Rubber, crude, tons	38,707	49,637	476,124	473,721	.05

[1] Sulphate equivalent of byproduct coke oven production.
* Per cent of decline.

TRENDS OF PRODUCTION AND CONSUMPTION



CONTRACT BUYING FEATURES TRADING IN CHEMICAL MARKET

LARGE consuming industries continued to cut down their raw material requirements throughout the last month and call for deliveries against contracts showed an appreciable decline. Total consumption of chemicals in the final quarter of the year according to current estimates will fall short of that for the corresponding quarter of last year with practically all the consuming lines contributing in varying degrees to the slower movement.

Trading activity in recent weeks has been largely confined to contract placements for 1938 delivery. In most cases the volume of new contracts has been reported as satisfactory with prices generally the same as those which were in effect on 1937 deliveries. Where price changes were made the majority was in favor of buyers with an occasional advance as in the case of calcium carbide. Carbon black has been finding a competitive market and has been further reduced in price.

In the spot market an easy price tone has continued with a moderate decline in the weighted index for chemicals and a sharp break in the index for oils and fats. Practically all the vegetable oils sold at lower prices and animal fats likewise moved downwards. In the case of vegetable oils, price declines have a logical basis based on large stocks in sight but in the case of most chemicals the weakness has developed from a falling off in consuming demand which probably prevented a rising price trend as production costs are higher than they were a year ago.

In the cottonseed oil market, while prices have been lowered, there has been a partial recovery from the low point in the case of the crude product. Bids for crude oil were more numerous around the first of the month and it was reported that some of the buying interest was on government account. Disappearance of refined oil has been coming up to expectations and there is every indication that consumption for the current oil year will be unusually large.

Coal-tar chemicals were quiet so far as spot transactions were concerned but a fair volume of forward business was written in the way of contracts for next year delivery. Prices generally were steady with the slower consuming demand offset by reduced production schedules. Naphthalene is in a firm position with imported material holding above the prices which importers have been bidding.

A reduction in the sales list for acetate of lime caused some speculation regarding the stability of acetic acid values. It is possible that quotations for the acid may be revised but producers no longer are bound by fluctuations in acetate of lime and it is probable that the present acid schedule will be maintained unless competitive tactics force a change. Of the mineral acids, hydrochloric appears to be most strongly entrenched as some sales are said to have been made at higher prices than were quoted a few months ago.

Action taken by the U. S. Department of Commerce, Bureau of Inspection and Navigation, in denying the right of entry to a shipment of whale oil, enroute to this country from the foreign freighter Charles Racine, has pleased domestic producers of fats and oils.

The cargo, amounting to approximately 12,000 tons, reached Norfolk about the middle of November, and the order forbidding landing the oil, was issued November 17, and was a climax to the controversy which has been raging since the imposition of the three cent import tax in 1934. The production of whale oil has increased heavily in that period until it has become a decidedly menacing rival of domestic cottonseed oil, tallow, corn oil, soyabean oil, and other oils used in edible products and in manufacture of soap.

Intensified search for natural soap materials is reported from Japan and Germany where conditions affecting supplies of such materials are declared to have become acute. Reports from Frankfort-on-Main and from Tokyo, to the Bureau of Foreign and Domestic Commerce reveal the crisis in those countries. The Irish Free State also is feeling a pinch in these commodities and an order of the Executive Council in Dublin, issued at the end of October, authorized the importation of 1,400 cwt. of soap and soap powders between Dec. 1 of this year and May 31, next.

Shortage of natural soap materials in Germany has forced keen study of the situation in a hunt for substitutes, and the government is aiding where possible. Under a recent decree all wine producers are called upon to deliver grape skins and kernels at designated receiving station for processing and oil recovery. This oil, while not edible, is reported suitable for technical uses in manufacture of soaps, paints, varnishes, linoleums and artificial leathers. Germany also is pressing development of production of technical synthetic fats.

Important Corrections!

"Principal Products and Plants of American Chemical Industry," pp. 689, 690, Nov. *Chem & Met.* contained two regrettable errors of omission and commission:

The Columbia Alkali Corp. with plants and general sales offices at Barberton, Ohio, was unintentionally omitted. It is a leading manufacturer of soda ash, caustic soda, sodium bicarbonate, modified sodas, calcium chloride, liquid chlorine and "Calcene."

Pittsburgh Plate Glass Co., Pittsburgh, Pa., parent company of both the Columbia Alkali Corp. and Southern Alkali Corp. with more than 20 plants, has seven manufacturing divisions specializing in glass, chemicals, paint, varnish and lacquers, brushes, refractories, mines and quarries, and industrial research.

Metal & Thermit Corp. with plants at Jersey City and Carteret, N. J., East Chicago, Ind., and South San Francisco, Calif., specializes in tin, antimony and titanium salts, thermite for welding, carbon-free alloys, and Murex welding rods.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	**89.28**
Last month	89.59
December, 1936	86.87
December, 1935	87.35

Calcium chloride and bichromates were among the few chemicals which were strong in price with weakness in carbon black, lead carbonate, acetate of lime, copper sulphate, acetone, and tin salts. In fact most of the metal salts were easy in price.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	**77.02**
Last month	83.11
December, 1936	97.49
December, 1935	93.05

Lower prices were quite common throughout the market for oils and fats. Crude cottonseed, linseed, China wood, coconut, palm, and red oils closed below the price levels of a month ago. Tallow and other animal fats also were lower.

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.05½–$0.06½	$0.06 –$0.07	$0.07 –$0.08
Acid, acetic, 28%, bbl., cwt.	2.38 – 2.63	2.38 – 2.63	2.45 – 2.70
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. reagent	10.25 –10.50	10.25 –10.50	10.52 –10.77
Boric, bbl., ton	105.00–115.00	105.00–115.00	105.00–115.00
Citric, kegs, lb.	.24 – .27	.24 – .27	.25 – .28
Formic, bbl., ton	.10½– .11	.10½– .11	.11 – .11½
Gallic, tech., bbl., lb.	.75 – .78	.75 – .78	.60 – .65
Hydrofluoric 30% carb., lb.	.07 – .07½	.07 – .07½	.07 – .07½
Lactic, 44%, tech., light, bbl., lb.	.06½– .06½	.06½– .06½	.11½– .12
Muriatic, 18°, tanks, cwt.	1.05 –.....	1.05 –.....	1.00 – 1.10
Nitric, 36°, carboys, lb.	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –.....	18.50 –20.00
Oxalic, crystals, bbl., lb.	.10½– .12	.10½– .12	.11½– .12½
Phosphoric, tech., c'boys., lb.	.09 – .10	.09 – .10	.09 – .10
Sulphuric, 60°, tanks, ton	13.00 –.....	13.00 –.....	11.00 –11.50
Sulphuric, 66°, tanks, ton	16.50 –.....	16.50 –.....	15.50 –.....
Tannic, tech., bbl., lb.	.40 – .45	.40 – .45	.20 – .30
Tartaric, powd., bbl., lb.	.24½– .25½	.24½– .25½	.24 – .25
Tungstic, bbl., lb.	2.75 –.....	2.75 –.....	2.50 – 2.75
Alcohol, Amyl	.....	.....	.....
From Pentane, tanks, lb.	.123–.....	.123–.....	.143–.....
Alcohol, Butyl, tanks, lb.	.08½–.....	.08½–.....	.08½–.....
Alcohol, Ethyl, 190p'f., bbl., gal.	4.14 –.....	4.14 –.....	4.14 –.....
Denatured, 190 proof			
No. 1 special, dr., gal wks.	.34 –.....	.34 –.....	.32 –.....
Alum, ammonia, lump, bbl., lb.	.03 – .04	.03 – .04	.03 – .04
Potash, lump, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Aluminum sulphate, com bags cwt.	1.35 – 1.50	1.35 – 1.50	1.35 – 1.50
Iron free, bg., cwt.	2.00 – 2.25	2.00 – 2.25	2.00 – 2.25
Aqua ammonia, 26°, drums, lb.	.02½– .03	.02½– .03	.02½– .03
tanks, lb.	.02½– .02½	.02½– .02½	.02½– .02½
Ammonia, anhydrous, cyl., lb.	.15½–.....	.16.....	.15½– .16
tanks, lb.	.04½–.....	.04½–.....	.04½–.....
Ammonium carbonate, powd tech., casks, lb.	.08 – .12	.08 – .12	.08 – .12
Sulphate, wks., cwt.	1.40 –.....	1.40 –.....	1.25 –.....
Amylacetate tech., tanks, lb.	.11½– .12	.11½– .12	.12 –.....
Antimony Oxide, bbl., lb.	.14½– .15	.15½– .16	.12½– .13
Arsenic, white, powd., bbl., lb.	.03 – .03½	.03 – .03½	.03½– .04
Red, powd., kegs, lb.	.15½– .16	.15½– .16	.15½– .16
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	56.50 –58.00
Chloride, bbl., ton	72.00 –74.00	72.00 –74.00	72.00 –74.00
Nitrate, cask, lb.	.07 – .08	.07 – .08	.08½– .09
Blanc fixe, dry, bbl., lb.	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f. o. b., wks., drums, cwt.	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	46.00 –51.00	46.00 –51.00	44.00 –49.00
Bromine, cs., lb.	.30 – .32	.30 – .32	.36 – .38
Calcium acetate, bags	1.65 –.....	1.95 –.....	2.10 –.....
Arsenate, dr., lb.	.06½– .07	.06½– .07	.06 – .07
Carbide drums, lb.	.05 – .06	.05 – .06	.05 – .06
Chloride, fused, dr., del., ton	21.50 –24.50	20.00 –33.00	20.00 –33.00
flake, dr., del., ton	23.00 –25.00	22.00 –35.00	22.00 –35.00
Phosphate, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb.	.05 – .06	.05 – .06	.05½– .06
Tetrachloride drums, lb.	.05½– .08½	.05½– .06	.05½– .06
Chlorine, liquid, tanks, wks., lb.	2.15 –.....	2.15 –.....	2.15 –.....
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb.	1.67 – 1.70	1.67 – 1.70	1.41 – 1.51
Copperas, bgs., f.o.b., wks., ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Copper carbonate, bbl., lb.	.09 – .16½	.09 – .16½	.11½– .16
Sulphate, bbl., cwt.	4.50 – 4.75	4.75 – 5.00	4.15 – 4.40
Cream of tartar, bbl., lb.	.19½– .20	.19½– .20	.16½– .17
Diethylene glycol, dr., lb.	.22 – .23	.22 – .23	.16½– .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 – 2.00	1.80 – 2.00	1.80– 2.00
Ethyl acetate, drums, lb.	.07½–.....	.07½–.....	.07 –.....
Formaldehyde, 40%, bbl., lb.	.05½– .06½	.05½– .06½	.06 – .07
Furfural, dr., lb.	.10 – .17½	.10 – .17½	.10 – .17½
Fusel oil, ref. drums, lb.	.16 – .18	.16 – .18	.16 – .18
Glaubers salt, bags, cwt.	.95 – 1.00	.95 – 1.00	.85 – 1.00
Glycerine, c.p., drums, extra, lb.	.15½–.....	.21½–.....	.21½–.....
Lead:			
White, basic carbonate, dry casks, lb.	.06½–.....	.07½–.....	.06½–.....
White, basic sulphate, sck., lb.	.06½–.....	.07½–.....	.06½–.....
Red, dry, sck., lb.	.07½–.....	.07½–.....	.077–.....
Lead acetate, white crys., bbl., lb.	.12 – .13	.12 – .13	.11 – .11½
Lead arsenate, powd., bbl., lb.	.13 – .13½	.13 – .13½	.09 – .10
Lime, chem., bulk, ton	8.50 –.....	1.07½–.....	1.067–.....
Litharge, pwd., csk., lb.	.06½–.....	.07½–.....	.067–.....
Lithophone, bags, lb.	.04½– .04½	.04½– .04½	.04½– .05
Magnesium carb., tech., bags, lb.	.06 – .06½	.06 – .06½	.06 – .06½

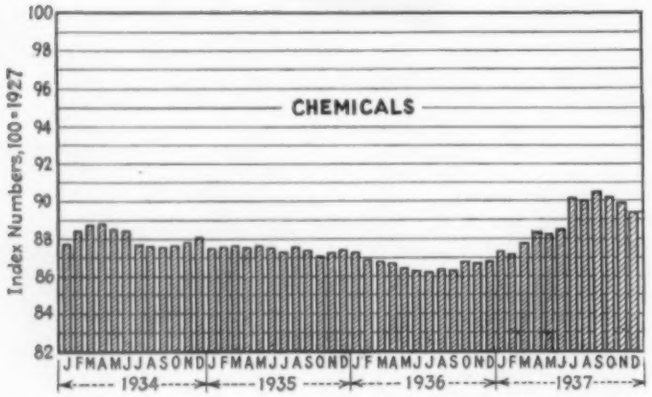
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal.	.31 –.....	.31 –.....	.33 –.....
97%, tanks, gal.	.32 –.....	.32 –.....	.34 –.....
Synthetic, tanks, gal.	.33 –.....	.33 –.....	.35½–.....
Nickel salt, double, bbl., lb.	.13 – .13½	.13 – .13½	.13 – .13½
Orange mineral, csk., lb.	.10½–.....	.10½–.....	.10½–.....
Phosphorus, red, cases, lb.	.40 – .42	.40 – .42	.44 – .45
Yellow, cases, lb.	.24 – .30	.24 – .30	.28 – .32
Potassium bichromate, casks, lb.	.08½– .09	.08½– .09	.08½– .09
Carbonate, 80–85%, calc. csk., lb.	.06½–.....	.06½–.....	.07 – .07½
Chlorate, powd., lb.	.09½–.....	.09½– .09	.08 – .08½
Hydroxide (c'stic potash) dr., lb.	.07 – .07½	.07 – .07½	.06½– .06½
Muriate, 80% bgs., ton	23.00 –.....	23.00 –.....	22.00 –.....
Nitrate, bbl. lb.	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb.	.18½– .19	.18½– .19	.18½– .19
Prussiate, yellow, casks, lb.	.15 – .16	.15 – .16	.18 – .19
Sal ammoniac, white, casks, lb.	.05 – .05½	.05 – .05½	.04½– .05
Salsoda, bbl., cwt.	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	13.00 –15.00	13.00 –15.00	13.00 –15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 –.....	1.23 –.....	1.23 –.....
Dense, bags, cwt.	1.25 –.....	1.25 –.....	1.25 –.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 – 3.00	2.60 – 3.00	2.60 – 3.00
Acetate, works, bbl., lb.	.04½– .05	.04½– .05	.04½– .05
Bicarbonate, bbl., cwt.	1.75 – 2.00	1.75 – 2.00	1.85 – 2.00
Bichromate, casks, lb.	.06½– .07	.06½– .07	.06½– .07
Bisulphate, bulk, ton	15.00 –16.00	15.00 –16.00	15.00 –16.00
Bisulphite, bbl., lb.	.03½– .04	.03½– .04	.03 – .04
Chlorate, kegs, lb.	.06½– .06½	.06½– .06½	.06½– .06½
Chloride, tech., ton	12.00 –14.75	12.00 –14.75	12.00 –14.75
Cyanide, cases, dom., lb.	.16½– .17	.16½– .17	.15½– .16
Fluoride, bbl., lb.	.07½– .08	.07½– .08	.07½– .08
Hyposulphite, bbl., cwt.	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt.	2.15 – 3.15	2.15 – 3.15	2.90 – 3.00
Nitrate, bags, cwt.	1.45 –.....	1.45 –.....	1.375–.....
Nitrite, casks, lb.	.07 – .08	.07 – .08	.07½– .08
Phosphate, dibasic, bags, lb.	1.85 –.....	1.70 –.....	.022– .024
Prussiate, yel. drums, lb.	.10 – .11	.10– .11	.10 – .11
Silicate (40° dr.) wks., cwt.	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr., lb.	.02½– .03½	.02½– .03	.02½– .03
Sulphite, cyrs., bbl., lb.	.02½– .02½	.02½– .02½	.02½– .02½
Sulphur, crude at mine, bulk, ton	18.00 –.....	18.00 –.....	18.00– .....
Chloride, dr., lb.	.03 – .04	.03 – .04	.03½– .04
Dioxide, cyl., lb.	.07 – .08	.06½– .08	.07 – .07½
Flour, bag, cwt.	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb.	.50 –.....	.52 –.....	.52 –.....
Crystals, bbl., lb.	.35 –.....	.34 –.....	.38½–.....
Zinc, chloride, gran., bbl., lb.	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb.	.14 – .15	.14 – .15	.09 – .11
Cyanide, dr., lb.	.36 – .38	.36 – .38	.36 – .38
Dust, bbl., lb.	.077–.....	.077–.....	.068–.....
Zinc oxide, lead free, bag., lb.	.06½–.....	.06½–.....	.05½–.....
5% lead sulphate, bags, lb.	.06½–.....	.06½–.....	.05½–.....
Sulphate, bbl., cwt.	3.15 – 3.60	3.15 – 3.60	2.65 – 3.00

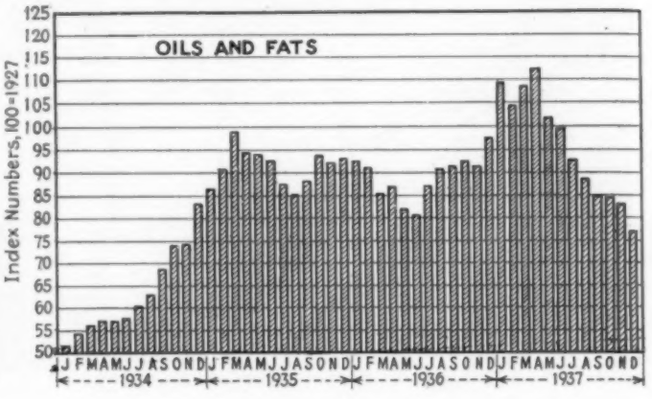
OILS AND FATS

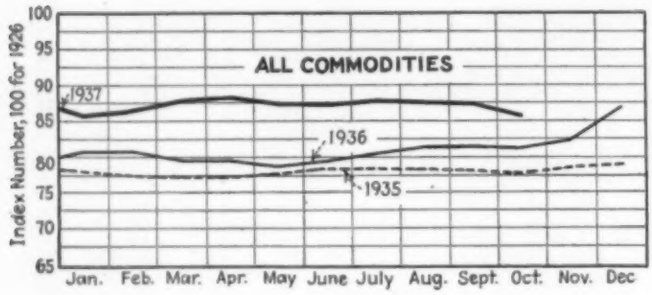
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½–$0.11	$0.10½–$0.11	$0.10 –$0.11
Chinawood oil, bbl., lb.	.14½–.....	.17 –.....	.13½–.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.04 –.....	.04½–.....	.07½–.....
Corn oil crude, tanks (f.o.b. mill), lb.	.06¼	.06½–.....	.09½–.....
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.05¾–.....	.06 –.....	.10 –.....
Linseed oil, raw car lots, bbl., lb.	.104–.....	.108–.....	.092–.....
Palm, casks, lb.	.04 –.....	.04½–.....	.05½–.....
Peanut oil, crude, tanks (mill), lb.	.06½–.....	.07½–.....	.09½–.....
Rapeseed oil, refined, bbl., gal.	.90 –.....	.92 –.....	.75 –.....
Soya bean, tank, lb.	.06 –.....	.06 –.....	.08½–.....
Sulphur (olive foots), bbl., lb.	.09½–.....	.09½–.....	.09½–.....
Cod, Newfoundland, bbl., gal.	.52 –.....	.52 –.....	.43 –.....
Menhaden, light pressed, bbl., lb.	.074–.....	.074–.....	.074–.....
Crude, tanks (f.o.b. factory), gal.	.34 –.....	.35 –.....	.35 –.....
Grease, yellow, loose, lb.	.05 –.....	.05½–.....	.07½–.....
Oleo stearine, lb.	.09 –.....	.09 –.....	.09 –.....
Red oil, distilled, d.p. bbl., lb.	.09½–.....	.10½–.....	.09½–.....
Tallow extra, loose, lb.	.06½–.....	.06½–.....	.07½– .....

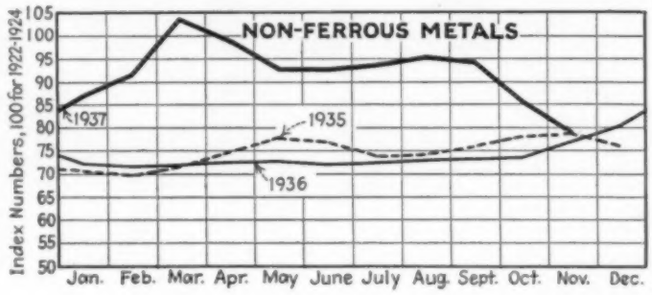
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to December 13

CHEM. & MET.'S WEIGHTED PRICE INDEXES









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$0.52 –$0.55	$0.52 –$0.55	$0.60 –$0.62
Alpha-naphthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.15 – .16
Aniline salts, bbl., lb.	.22 – .24	.22 – .24	.24 – .25
Benzaldehyde, U.S.P., dr., lb.	.85 – .95	.85 – .95	1.10 – 1.25
Benzidine base, bbl., lb.	.70 – .75	.70 – .75	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.52 – .54	.52 – .54	.48 – .52
Benzyl chloride, tech., dr., lb.	.25 – .27	.25 – .27	.30 – .35
Benzol, 90%, tanks, works, gal.	.16 – .18	.16 – .18	.16 – .18
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.23 – .24
Cresol, U.S.P., dr., lb.	.12 – .13	.12 – .13	.10 – .11
Cresylic acid, 99%, dr., wks., gal.	.89 – .92	.92 – 1.00	.73 – .75
Diethylaniline, dr., lb.	.50 – .55	.50 – .55	.55 – .58
Dinitrophenol, bbl., lb.	.23 – .25	.23 – .25	.29 – .30
Dinitrotoluen, bbl., lb.	.15 – .16	.15 – .16	.16 – .17
Dip oil, 25%, dr., gal	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.32 – .36	.32 – .36	.38 – .40
H-acid, bbl., lb.	.50 – .55	.50 – .55	.65 – .70
Naphthalene, flake, bbl., lb.	.07½– .07¾	.07½– .07¾	.07½– .07¾
Nitrobenzene, dr., lb.	.08 – .09	.08 – .09	.08¾– .10
Para-nitraniline, bbl., lb.	.45 – .47	.45 – .47	.45 – .47
Phenol, U.S.P., drums, lb.	.14½–.....	.14½–.....	.14½– .15
Picric acid, bbl., lb.	.35 – .40	.35 – .40	.30 – .40
Pyridine, dr., gal	1.55 – 1.60	1.55 – 1.60	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.75 – .80	.75 – .80	.65 – .70
Salicylic acid, tech., bbl., lb.	.34 – .40	.34 – .40	.40 – .42
Solvent naptha, w.w., tanks, gal.	.30 –.....	.30 –.....	.26 –.....
Tolidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.35 –.....	.35 –.....	.30 –.....
Xylene, com, tanks, gal.	.35 –.....	.35 –.....	.30 –.....

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.12 – .13	.12½– .13	.17½– .18
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.03 – .20	.0395– .20	.04 – .20
Prussian blue, bbl., lb.	.36 – .37	.37 – .38	.37 – .38
Ultramarine blue, bbl., lb.	.10 – .26	.10 – .26	.10 – .26
Chrome green, bbl., lb.	.21 – .30	.21 – .30	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.75 – .80	.75 – .80	.75 – .80
Vermilion, English, bbl., lb.	1.60 – 1.65	1.75 – 1.80	1.59 – 1.60
Chrome yellow, C. P., bbl., lb.	.14½– .15½	.14½– .15½	.12 – .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.06 – .06½	.06 – .06½	.07 – .08½
Gum copal Congo, bags, lb.	.08 – .30	.08 – .30	.08 – .30
Manila, bags, lb.	.08½– .14	.08½– .14	.09 – .14
Damar, Batavia, cases, lb.	.16 – .24	.16 – .24	.15½– .16
Kauri cases, lb.	.18½– .60	.18½– .60	.19 – .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton	50.00 –.....	50.00 –.....	50.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	6.40 –.....	7.75 –.....	10.65 –.....
Turpentine, gal.	.31 –.....	.31½–.....	.45½–.....
Shellac, orange, fine, bags, lb.	.21 –.....	.22 –.....	.25 –.....
Bleached, bonedry, bags, lb.	.17 –.....	.17 –.....	.17½–.....
T. N. Bags, lb.	.12 –.....	.12 –.....	.13½–.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton.	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –.....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

JENKINS BROS., New York, has opened a branch office and warehouse at 376 Spring St., Atlanta, Ga., with C. B. Yardley as manager.

MORRIS MACHINE WORKS, Baldwinsville, N. Y., is now represented in Salt Lake City by the Lang Co. with offices at 267 West First St.

ROOTS–CONNERSVILLE BLOWER CORP., Connersville, Ind., has appointed as its distributors, the Buffalo Mill Supply Co., Inc., 210 Main St., Buffalo, and F. W. Allen & Son, 2658 W. 26th St., Erie, Pa.

STRUTHERS WELLS–TITUSVILLE CORP., Warren and Titusville, Pa., has appointed R. J. Reed manager of its Titusville iron works division. Mr. Reed is succeeded as sales manager by Douglas E. Penning.

HANSON–VAN WINKLE–MUNNING CO., Matawan, N. J. and Anderson, Ind., has appointed The Chamberlain Co., Los Angeles as its distributor in southern California.

TENNESSEE EASTMAN CORP., Kingsport, Tenn., has moved its New York office to 10 East 40th St. William L. Searles is in charge, assisted by John P. Tokarz.

WORTHINGTON–GAMON METER CO., Harrison, N. J., has appointed W. C. Flanders sales manager to succeed G. H. Gleeson who recently resigned.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1937	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$25,000	.....	$1,610,000	$2,702,000
Middle Atlantic	.....	$201,000	17,292,000	17,151,000
South	1,415,000	171,000	31,010,000	38,498,000
Middle West	540,000	1,580,000	14,093,000	24,207,000
West of Mississippi	495,000	200,000	18,832,000	12,578,000
Far West	990,000	1,400,000	9,825,000	10,848,000
Canada	13,300,000	750,000	46,580,000	9,032,000
Total	$16,765,000	$4,302,000	$139,242,000	$115,016,000

PROPOSED WORK

Clay Products Plant—Alberta Clay Products Ltd., Medicine Hat, Alta., Can., plans to construct a plant for the manufacture of glazed tile, brick and stoneware. Estimated cost $100,000.

Cork Factory—Armstrong Cork Co., 1206 Maple Ave., Los Angeles, Calif., will soon take bids for the construction of a 1 story, 80x240 ft. factory at South Dale, Calif. Henry Boettcher, 1206 Maple Ave., Archt. Estimated cost $100,000.

Fertilizer Factory—Dixie Chemical Corp., Kinston, N. C., contemplates the construction of a fertilizer factory at New Bern, N. C.

Gas Plant—Utilities Commission, King St., Kitchener, Ont., Can., plans to either buy gas from the Dominion Natural Gas Co., 1307 Duke St., Preston, Ont., which will necessitate laying 5 mi. of mains or to construct its own artificial plant. Plans are now being studied and the Commission is interested in prices and information. Cost figures are indefinite but may possibly reach $200,000. V. S. McIntype, c/o company, Engr.

Glass Factory—Standard Glass Co., Anderson, Ind., plans addition to plant at Winchester, Ind., necessitated by consolidation of plant. Estimated cost including equipment $40,000.

Paint Factory—Pacific Paint & Varnish Co., Cedar and 4th Sts., Berkeley, Calif., plans to construct a 1 story, 50x100 ft. addition to its factory. Bids are being received by W. H. Ellison, archt., Pacific Bldg., San Francisco.

Paint Factory—Socony Paint Products Co., 26 Bway., New York, N. Y., is receiving bids for the construction of a 4 story, 100x100 ft. factory at Chicago, Ill. Estimated cost $100,000.

Pottery Plant—Hartford Faience Co., 175 Bartholomew Ave., Hartford, Conn., is having plans prepared by Robertson & Co., Inc., Engrs., 1262 Hanna Bldg., Cleveland, O., for the construction of a kiln tunnel, 130 ft. long and 12 ft. wide at its pottery plant here. $25,000.

Pulp Mill—Bowater & Lloyd Co., 121 Queen Victoria St., London E. C. 4, England, contemplates the construction of a sulphate pulp mill at Gander Lake, Newfoundland. Estimated cost $6,000,000.

Pulp Mill—English River Pulp Co., Ltd., 372 Bay St., Toronto, Ont., Can., plans the construction of a pulp mill at Kenora, Ont., to include 35 mi. railway. Goggin & Ripley, Inc., 350 Madison Ave., New York, N. Y., Engrs. Estimated cost $2,000,000.

Pulp Mill—North Carolina Pulp Mill, L. J. Meumier, Vice Pres., Plymouth, N. C., plans to construct a finishing mill. Estimated cost $300,000.

Pulp Mill—Western Pulp & Paper Co., Ltd., 372 Bay St., Toronto, Ont., Can., plans to construct a pulp and paper mill at Fort William, Ont., Goggin & Ripley, Inc., 350 Madison Ave., New York, N. Y., Engrs. Estimated cost $5,000,000.

Rayon Mill—American Enka Corp., A. J. L. Moritz, Vice Pres., Enka, N. C., plans improvements, additions and replacements at its mill. Estimated cost $500,000.

Research Building—Proctor & Gamble Co., Spring Grove Ave., Ivorydale, O., will soon award the contract for the construction of a research, engineering and administration building at its plant. Ralph M. Rice, Archt., and Henry Manley, Engr., both at 655 Fifth Ave., New York, N. Y. Estimated cost $400,000.

Refinery—Amerada Oil Co., Tulsa, Okla., plans to construct a natural gasoline plant at Langston, Okla. Estimated cost $50,000.

Refinery—Continental Oil Co., Ponca City, Okla., plans to increase the capacity of its refinery at Denver, Colo., from 2,000 bbl. to 4,000 bbl. Estimated cost $75,000.

Refinery—Imperial Oil Co., Spokane, Wash., plans to enlarge its refinery. Estimated cost $350,000.

Refinery—Magnolia Petroleum Co., Magnolia St., Dallas, Tex., plans to construct a carbon black plant at Stonewall, Okla. Estimated cost $75,000.

Refinery—Refugio Refining Co., Edinburg, Tex., plans to construct a casinghead gasoline plant at its refinery at La Blanca, Tex. Estimated cost $125,000.

Refinery—South Arkansas Refining Co., Shreveport, La., plans to construct a 3,500 bbl. refinery near Ravana, Ark.

Refinery—Southern State Refining Co., Gulfport, Miss., plans improvements at its refinery. Estimated cost $75,000.

Refinery—Southwestern Oil & Refining Co., Lake Charles, La., plans to construct a 5,000 bbl. oil refinery here. Estimated cost $500,000.

Refinery—Tidewater and Seaboard Oil Companies, Palestine, Tex., plan to construct a modern gas stripping and repressuring plant on a 10 acre plot of ground recently purchased in the Cayuga Fields near Palestine, Tex. Process will be taking gas from Trinity sand, extracting the distillate, and forcing the residue into the Woodbine.

Refinery—Universal Oil Refining Co., Amarillo, Tex., plans to construct a new refinery at Pueblo, Colo. Estimated cost $50,000.

Sodium Chlorate Plant—Pennsylvania Salt Manufacturing Co., Philadelphia, Pa., and Chipman Chemical Co., Inc., Bound Brook, N. J., plan to construct a sodium chlorate plant at Bonneville, Ore., near Bonneville Dam. Estimated cost will exceed $500,000.

Wood Creosoting Plant—George H. Hutchins, Longview, Tex., plans to construct a wood creosoting plant at Lufkin, Tex., to have an annual capacity of 26,000,000 bd. ft. New machinery will be purchased.

CONTRACTS AWARDED

Alkali Plant—Michigan Alkali Co., Wyandotte, Mich., will construct an alkali plant. Owner will purchase materials and construct by day labor. Estimated cost $1,000,000.

Coke Ovens—American Rolling Mill Co., Hamilton Coke & Iron Division, Middletown, O., has awarded the contract for the construction of 15 coke ovens, each of 15 ton capacity, at New Miami, O., to Koppers Co., Pittsburgh, Pa. Estimated cost $500,000.

Gas Plant—Public Utilities Comn., Owen Sound, Ont., Can., has awarded the contract for rehabilitation of gas plant to Curran Knowles Carbonization Co., West Frankfort, Mo., who will supervise construction by day labor and supply blue prints. Contract is awarded subject to confirmation of bylaw at January elections. Estimated cost $165,000.

Gasoline Plant—Continental Oil Co., Ponca City, Okla., has awarded the contract for the construction of a casinghead natural gasoline plant at Billings, Okla., to Stearns-Rogers Co., 1720 California St., Denver, Colo. Estimated cost $50,000.

Oxygen Plant—American Oxygen Service Corp., G. E. Roth, Treas., Harrison, N. J., has awarded the contract for a 2 story, 100x108 ft. addition to plant to Mahony-Troast Constr. Co., 657 Main St., Passaic, N. J., and Truscon Steel Co., 1315 Albert St., Ext., Youngstown, O. Estimated cost including equipment $135,000.

Oil Processing Building—Proctor & Gamble Manufacturing Co., 1601 West 7th St., Long Beach, Calif., has awarded the contract for superstructure for 6 story oil processing building and 6 story fish products building to Ford J. Twaits Co., 816 West 5th St., Los Angeles. Estimated cost $1,000,000.

Paper Mill—Consolidated Paper Corp., Ltd., 155 Metcalfe St., Montreal, Que., Can., has awarded contracts for modernization of its mill at Shawinigan Falls and Three Rivers, Que.; steel to Dominion Bridge Co., Ltd., Lachine, Que., and construction to J. P. Morin, 50 Richilieu St., Cap de La Madeleine, Que. Estimated cost $400,000 each.

Plywood Plant—Anacortes Plywood Co., Anacortes, Wash., will construct a plywood plant by day labor and separate contracts. Estimated cost $400,000.

Pottery Plant—Crane Poreclain & Pottery Mfg. Co., c/o M. Rice, 516 West Laurel St., San Antonio, Tex., will construct a plant at Somerset, Tex. Work will be done by separate contracts. Estimated cost $60,000.

Pottery Plant—Taylor, Smith & Taylor Pottery Co., Chester, W. Va., has awarded the contract for an addition to its plant to Nellis Construction Co., East Liverpool, O. Estimated cost $40,000.

Pulp Mill—Lake Sulphide Pulp Co., Ltd., 210 St. James St. W., Montreal, Que., Can., has awarded the contract for the construction of a bleaching plant at Red Rock, Ont., to Alex Fleck, Ltd., 416 Wellington St., Ottawa. Estimated cost $150,000.

Pulp Mill—Merritt, Chapman & Scott, 17 Battery Pl., New York, N. Y., who are now building a pulp mill for the National Container Corp. at Jacksonville, Fla., have been awarded an additional contract for constructing a recovery plant to cost $75,000 and a bark burner to cost approximately $1,400.

Refinery—Barnsdall Oil Co., Tulsa, Okla., has awarded the contract for the construction of a 12,000,000 cu. ft. capacity casing head gasoline plant near Odessa, Tex., to Petroleum Engineering Co., Inc., Tulsa. Estimated cost $50,000.

Refinery—The Texas Co., 135 East 42nd St., New York, N. Y., has awarded the contract for a two stage atmospheric and vacuum still plant at Port Neches, Tex., to Alco Products, Inc., 30 Church St., New York, and Dunkirk, N. Y.

Rubber Factory—Joseph Stokes Rubber Co., P. O. Gunkel, Gen. Mgr., John St., Welland, Ont., Can., manufacturer of hard rubber goods, has awarded the contract for the construction of a factory to Timms Construction Co., Burgar St., Welland. Estimated cost $35,000.

Soap Factory—Proctor & Gamble Co., 1232 West North Ave., Chicago, Ill., has awarded the contract for a top addition to its factory to William Mavor Co., 7 South Dearborn St., Chicago.

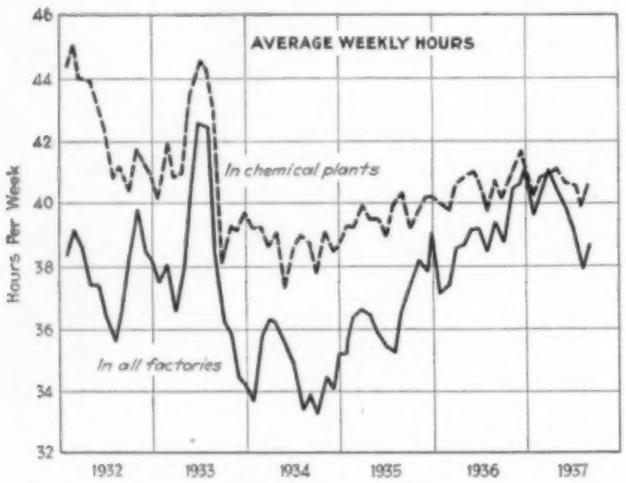
Warehouse—Federal Chemical Co., Starks Bldg., Louisville, Ky., has awarded the contract for a 1 story warehouse addition to W. S. Langford Co., Boston, Ky. Estimated cost $40,000.

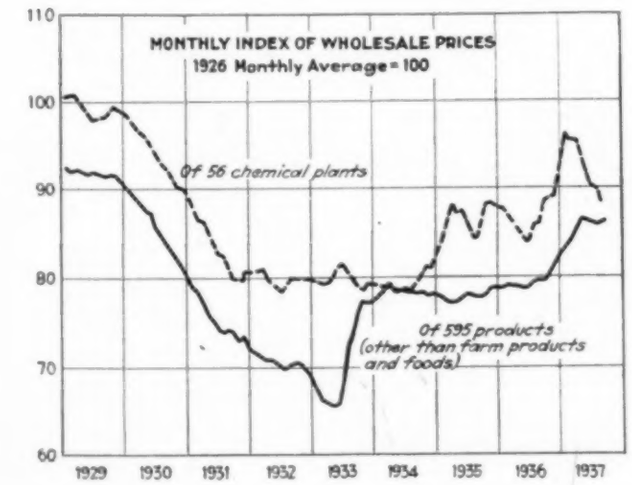
Warehouse—Glencoe Distillery Co., 660 South 4th St., Louisville, Ky., has awarded the contract for a whiskey warehouse on Cane Run Rd., to Dahlem Construction Co., 1249 South Shelby St., Louisville. Estimated cost $55,000.

Warehouse—Wight Distilling Co., Gillet Bldg., Baltimore, Md., has awarded the contract for the construction of a 5 story, 100x200 ft. warehouse at Lorelei, Baltimore Co., to G. Walter Tovell, Eutaw and Monument Sts., Baltimore. Estimated cost $66,000.

COMPARISON OF FACTORY EMPLOYMENT AND PAYROLLS

Compiled by The Manufacturing Chemists' Association
From Bureau of Labor Statistics





CHEMICAL INDUSTRIES

16th Exposition

WEEK OF DECEMBER 6, 1937

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Pres., American Chemical Society

EXHIBITOR-ADVERTISER SECTION

Grand Central Palace • New York City

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Abbe Engineering Co., Inc., 50 Church St., New York, N. Y.	33
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American Hard Rubber Co., 11 Mercer St., New York, N. Y.	545–546
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Ansul Chemical Co., Paoli, Pa.	81
Artisan Metal Products Co., 205 E. 42nd St., New York, N. Y.	547–548
Associated Cooperage Industries of America, Inc., 411 Olive St., St. Louis, Mo.	325
Atlas Electric Devices Co, 361 W. Superior St., Chicago, Ill.	510–511
Atlas Powder Co., Wilmington, Del.	46
Bailey Meter Company, 1050 Ivanhoe Road, Cleveland, O.	246
Bakelite Corporation, 247 Park Ave., New York, N. Y.	17
Baker & Co., Inc., Murray & Austin Sts., Newark, N. J.	314–315
Baker-Perkins Co. Inc., 250 Park Ave., New York N. Y.	62–63
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Barrett-Cravens Co., 3255 West 30th St., Chicago, Ill.	228–229–230
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Bristol Company, The, Waterbury, Conn.	83–84
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Callite Products Division, 540 39th St., Union City, N. J.	407–408
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Chemical Industries, 149 Temple St., New Haven, Conn.	28
Chemical & Metallurgical Engineering, 330 W. 42nd St., New York, N. Y.	42
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Coleman Electric Co., 310 Madison St., Maywood, Ill.	338–339
Columbia Steel Co., San Francisco, Calif.	19–20
Combustion Engineering Co., Inc. (Raymond Pulverizer Div.), 1319 N. Branch St., Chicago, Ill.	67
Commercial Solvents Corp., 230 Park Ave., New York, N. Y.	78
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Crane Co., 836 S. Michigan Ave., Chicago, Ill.	312–313
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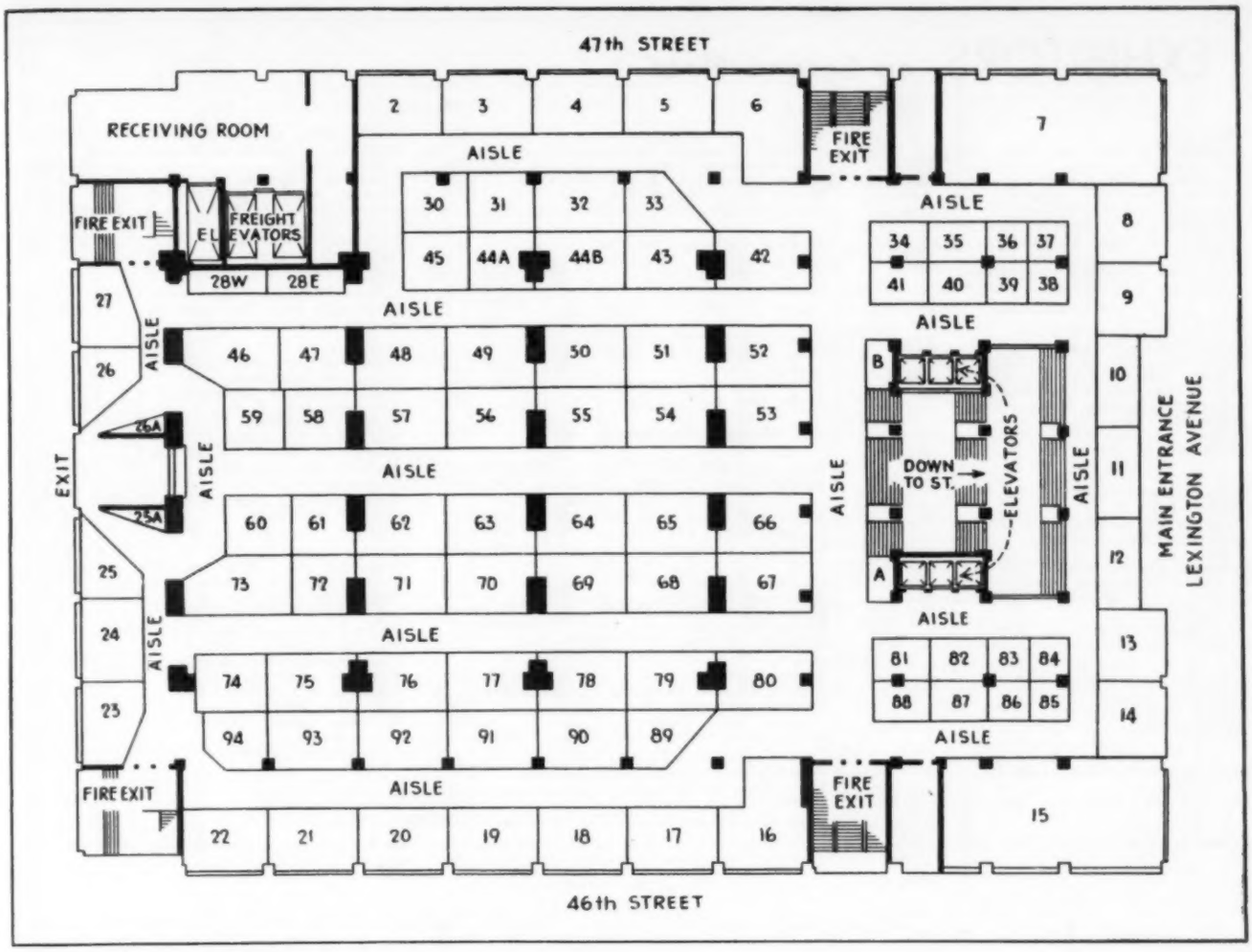

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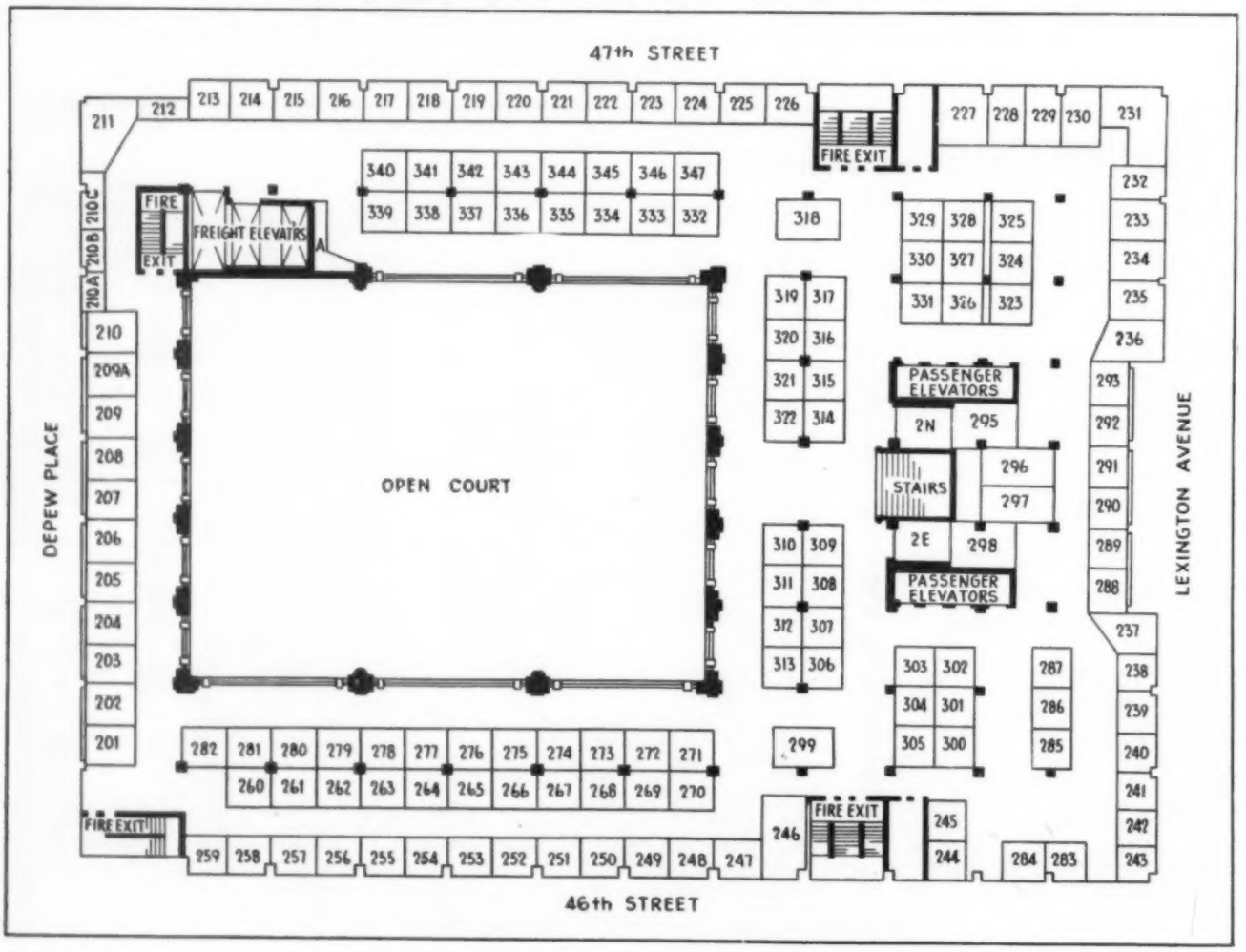

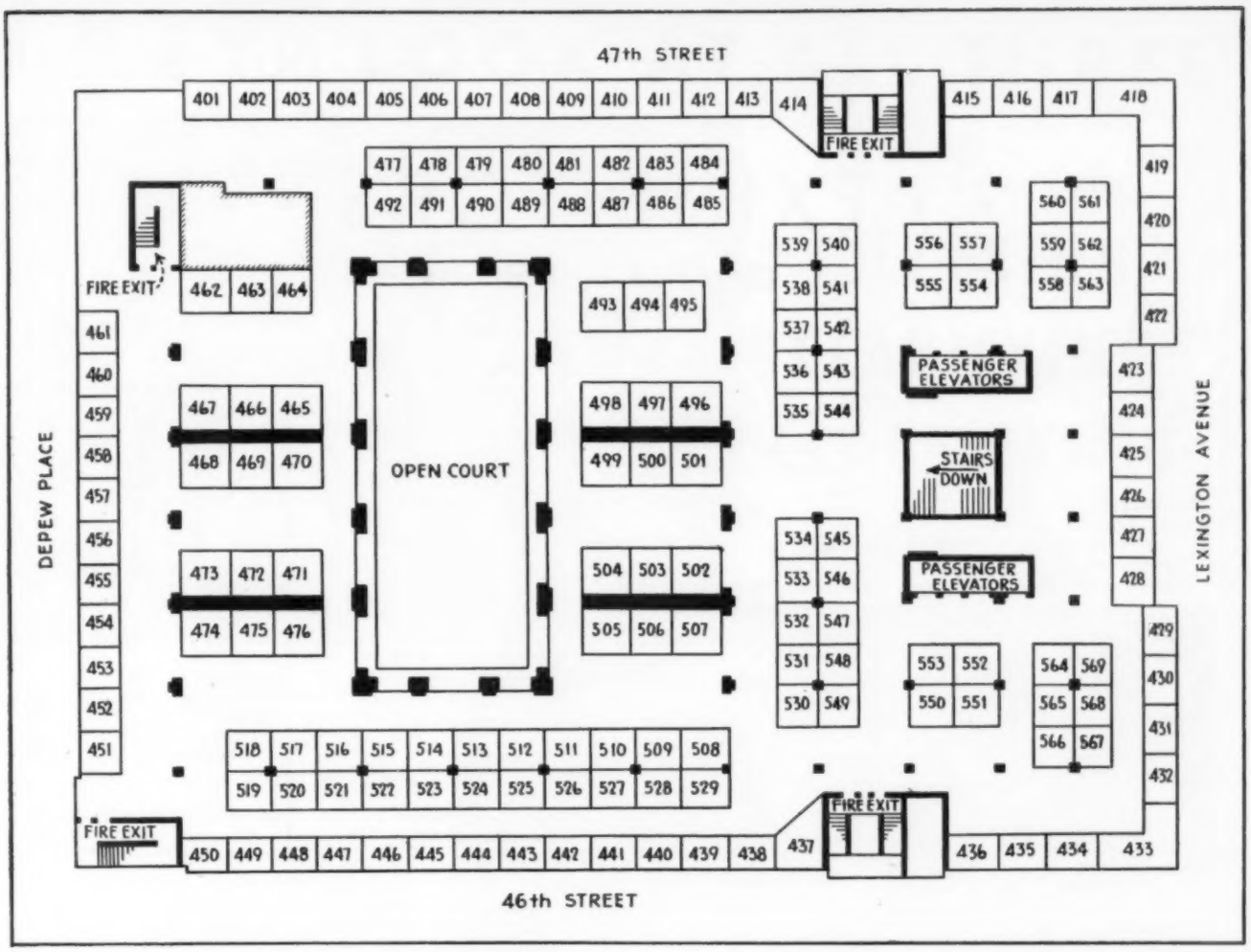

• EXHIBITORS on Third Floor

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Acme Steel Company	427–428
Allegheny Steel Company	540–541–542
American Hard Rubber Co.	545–546
American Machine & Foundry Co.	516–517 518–519–520–521
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Index as supplied by International Exposition Company, corrected to Nov. 5

• • EXHIBITORS • •

Classified by Products

ABRASIVES
Bakelite Corp.
Carborundum Co.
Dicalite Co.
Norton Co.
Pangborn Corp.
Sabin Machine Co.

ACIDIFIERS
Chas. Pfizer & Co. Inc. (ascorbic, citric, tartaric, glucomic)
Sprout, Waldron & Co.

ACIDS
Eimer & Amend
Electro Bleaching Gas Co.
Hercules Powder Co.
Niagara Alkali Co.
U. S. Stoneware Co.
Wishnick Tumpeer, Inc.

ACID PLANTS
Amersil Co. Inc.
Andrews Lead Co. Inc.
Antaciron, Inc.
Duriron Co., Inc., The
Electro Chemical Supply & Engrg. Co.
Fansteel Metallurgical Corp.
General Ceramics Co.
Hills-McCanna Co.
Maurice A. Knight
Pfaudler Co.
U. S. Stoneware Co.

ACID RESISTING MATERIALS
Allegheny Steel Co.
Alsop Engineering Corp.
Aluminum Co. of America
American Hard Rubber Co.
Andrews Lead Co.
Antaciron, Inc.
Amersil Co. Inc.
Bakelite Corp.
Baker & Co. Inc.
J. Bishop & Co. Platinum Works (stainless steel tubing on wire, platinum and precious metals and alloys)
Crane Co.
Custodis Construction Co. Inc.
Duriron Co. Inc., The
Electro Chemical Supply & Engrg. Co.
Fansteel Metallurgical Corp.
Fish-Schurman Corp.
General Alloys Co.
General Ceramics Co.
Hercules Powder Co.
Hills-McCanna Co.
Haveg Corp.
Ingersoll Steel & Disc. Div. Borg-Warner Corp.
International Nickel Co. Inc.
Johns-Manville
Maurice A. Knight
Lead Lined Iron Pipe Co.
National Lead Co.
Norton Co.
Pfaudler Co.
Quigley Co. (brick, cements, protective coatings for steel)
E. H. Sheldon & Co.
Worthington Pump & Mchy. Corp.

ACTIVATED CARBON
Darco Corp.
Industrial Chemical Sales Div. West Virginia Pulp & Paper Co.

ADHESIVES
Bakelite Corp.
Eimer & Amend
Electro Chemical Supply & Engrg. Co.
Philadelphia Quartz Co.

ADMIXTURES
Dicalite Co. (concrete, asphalt)

AERATORS
Denver Equipment Co.

AGITATORS
Abbe Engineering Co.
Alsop Engineering Co.
American Hard Rubber Co.
Andrews Lead Co. Inc.
Antaciron, Inc.
Beach-Russ Co.
Blaw-Knox Co.
Buffalo Foundry & Machine Co.
J. H. Day Co., The
Denver Equipment Co. (for insertion in tanks, rubber covered)
J. P. Devine Mfg. Co. Inc.
Dorr Co., Inc., The
Duriron Co., Inc., The (acid resisting)
Eastern Engrg. Co.
Eimer & Amend
Ertel Engineering Corp.
Eppenbach, Inc.
Fansteel Metallurgical Corp.
General Ceramics Co.
Haveg Corp.
Lead Lined Iron Pipe Co.
Mixing Equipment Co. Inc. (Liquid and Fluid)
New England Tank & Tower Co.
N. J. Laboratory Supply Co.
National Lead Co. (homogenous lead lined)
Pfaudler Co.
Read Machinery Co.
Robinson Mfg. Co.
Sowers Mfg. Co.
Sprout, Waldron & Co.
Struthers-Wells
Turbo-Mixer Corp.
U. S. Stoneware Co.
Worthington Pump & Mchy. Corp.

AIR CLASSIFIERS—(see Classifiers)

AIR CONDITIONING APPARATUS
Monarch Mfg. Works, Inc.
Taylor Instrument Cos.
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mchy. Corp.

AIR FILTERS—(see Filters)

AIR SEPARATORS—(see SEPARATORS)

AIR TABLES
Separations Engineering Corp.
Sutton, Steele & Steele, Inc.

ALCOHOL
Atlas Powder Co.
Commercial Solvents Corp.
Eimer & Amend
Hercules Powder Co.
Industrial Chemical Sales Div. West Virginia Pulp & Paper Co.
Rossville
U. S. Industrial Alcohol Co.
U. S. Industrial Chemical Co.

ALKALIES
Eimer & Amend
Electro Bleaching Gas Co.
Niagara Alkali Co.
Philadelphia Quartz Co.
Wishnick Tumpeer Inc.

ALLOYS—Ferrous
Allegheny Steel Co.
Andrews Lead Co. Inc.
Antaciron, Inc.
Duriron Co. Inc., The
Eimer & Amend
General Alloys Co.
Ingersoll Steel & Disc Div. Borg-Warner Corp.
Rochester Engrg. & Centrifugal Corp.
Republic Steel Corp.
Titanium Alloy Mfg. Co.
Worthington Pump & Mchy. Corp.

ALLOYS—Non Ferrous
Allegheny Steel Co.
Aluminum Co. of America
Baker & Co. (precious metal alloys, and heat and corrosion resistant, for glass manufacture)
J. Bishop & Co. Platinum Works (platinum)
Duriron Co., The
Eimer & Amend
Hills-McCanna Co.
International Nickel Co. Inc.
Lead Lined Iron Pipe Co.
P. R. Mallory & Co. Inc.
Titanium Alloy Mfg. Co.
Worthington Pump & Mchy. Corp.

ANODES
Antaciron, Inc. (14½% Silicon Iron)
Duriron Co., Inc., The (insoluble)

ASBESTOS
American Seitz Filter Co. (filtering materials, filter sheets)

AUTOCLAVES
Andrews Lead Co. Inc.
Blaw-Knox Co.
Buffalo Foundry & Machine Co.
Duriron Co., Inc., The (acid resisting)
Eimer & Amend
Fansteel Metallurgical Corp.
Haveg Corp.
Ingersoll Steel & Disc. Div. Borg-Warner Corp.
Henry E. Jacoby
Lead Lined Iron Pipe Co.
National Lead Co. (homogenous lead lined)
Pfaudler Co.
Sowers Mfg. Co.
F. J. Stokes Machine Co.
Struthers-Wells

AUTOMATIC TEMPERATURE CONTROL
Bailey Meter Co.
Bristol Co.
Brown Instrument Co.
Eastern Engrg. Co.
Eimer & Amend
Fish-Schurman Corp. (for laboratory and optical instruments)
Foxboro Co.
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Precision Scientific Co.
Reeves Pulley Co. of N. Y. Inc.
Sarco Company, Inc.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos.

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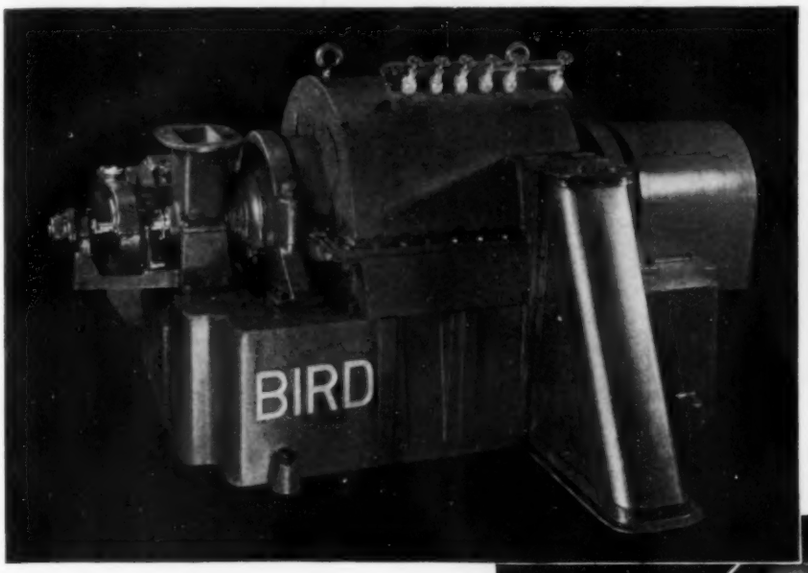
BOOTHS 535-536, 543-544

Be Sure You LOOK AT ALL THREE

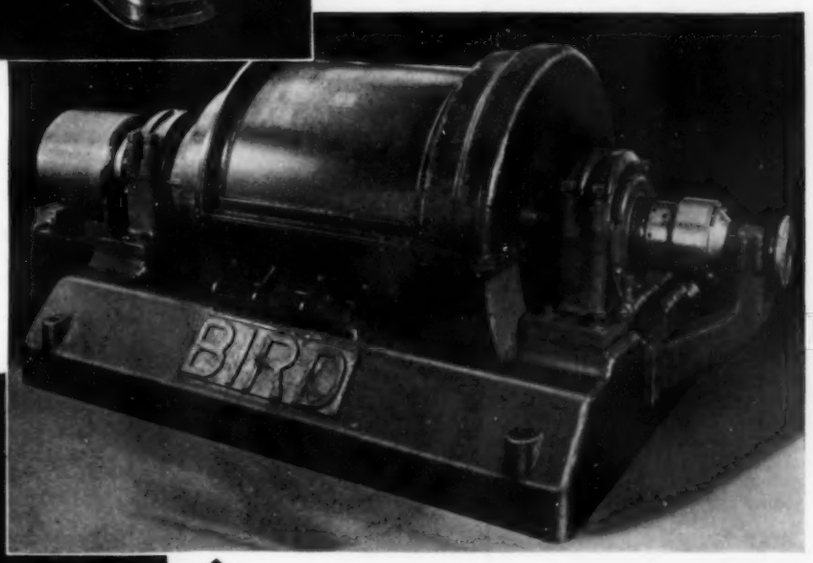


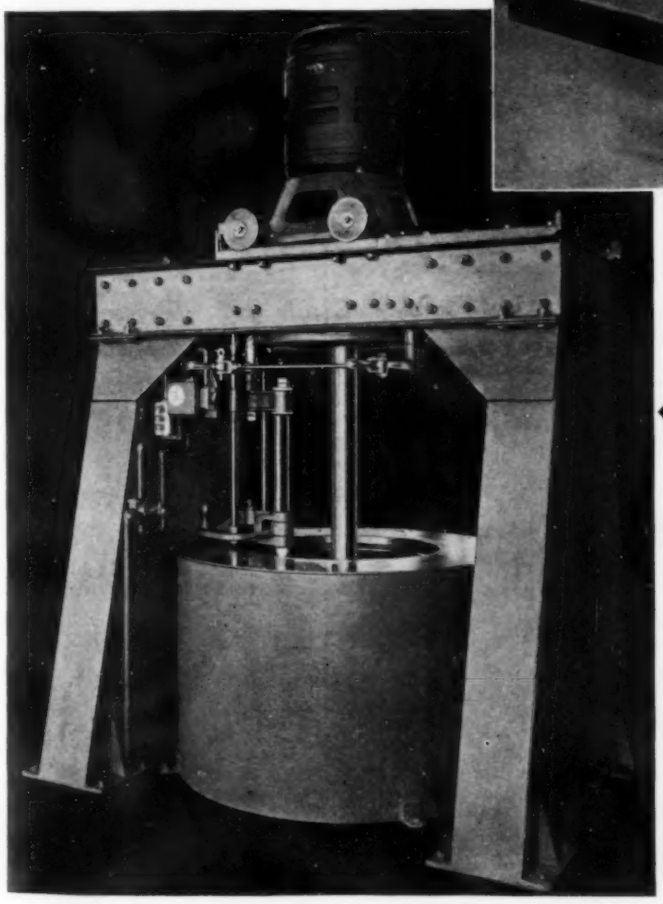
Whatever Your

FILTERING
CLARIFYING
CLASSIFYING

Problem

1 THE BIRD CENTRIFUGAL FILTER for continuous separation of crystalline or granular solids producing, in most cases, drier and more efficiently washed solids at lower cost than any other filtering equipment.





2 THE BIRD CONTINUOUS CENTRIFUGAL (Solid Bowl) for deliquoring or classifying slurries containing solids as fine as a fraction of a micron.

3 THE BIRD SUSPENDED CENTRIFUGAL, a heavy duty, high capacity batch machine designed to meet your particular problems, equipped with perforate or imperforate basket, unloader, fume hood, timer, etc.

ONE OF THESE THREE MACHINES IS THE ONE BEST BET FOR *YOUR* JOB.

See them at the CHEMICAL SHOW, BOOTH NOS. 535, 536, 543, and 544, or write for Bulletins

BIRD MACHINE CO.
SOUTH WALPOLE · MASS.

BAGS
Bemis Bro. Bag Co.
Paper Service Co. (vapor and waterproof)
St. Regis Paper Co. (paper)
Union Bag & Paper Co. (paper)

BALANCES AND WEIGHTS
Wm. Ainsworth & Sons, Inc.
Christian Becker, Inc.
Builders Iron Foundry, Inc.
Eimer & Amend
Exact Weight Scale Co.
Fairbanks, Morse & Co.
Newark Scale Works
N. J. Laboratory Supply Co.
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Read Machinery Co.
Seederer-Kohlbusch, Inc.

BARRELS AND DRUMS
Acme Steel Co. (hoops for)
Aluminum Co. of America
American Hard Rubber Co.
Associated Cooperage Industries of America, Inc. (beer)
Container Co., The
Ingersoll Steel & Disc Div. Borg-Warner Corp.
Maurice A. Knight
Pressed Steel Tank Co.
Republic Steel Corp.
Sabin Machine Co.
Stevens Metal Products Co.

BASKETS—Dipping
American Hard Rubber Co.
Duriron Co. Inc., The
General Alloys Co.
General Ceramics Co.
Maurice A. Knight
Korb-Pettit Wire Fabrics & Iron Works
Pittsburgh Steel Drum Co.
John A. Roebling's Sons Co.
U. S. Stoneware Co.

BATTERY PARTS
Corning Glass Works—Fibre Products Div. (glass fibre, bonded sheets)
Dicalite Co. (fillers)
Eimer & Amend

BEARINGS
Denver Equipment Co. (babbitt metal)
Link-Belt Co.

BELTS
Acme Steel Co.
Garlock Packing Co. (rubber)
Korb-Pettit Wire Fabrics & Iron Works (spiral weave conveyor)
Link-Belt Co. (chain)

BLOWERS
Abbe Engineering Co. (air)
Antaciron, Inc. (acid)
Beach-Russ Co. (air)
Eimer & Amend
General Ceramics Co.
Haveg Corp (acid and acid proof)
Palo-Myers, Inc. (air)
Pangborn Corp. (centrifugal)
U. S. Stoneware Co. (acid proof)

BOILER COVERING AND INSULATION
Corning Glass Works—Fibre Products Div.
Quigley Co.—(Insulblox refractory block insulation, Insulbrix insulating refractory brick, Insulcrete insulating refractory concrete, Insulag refractory lagging)
John A. Roebling's Sons Co.

BOILERS
Barnstead Still & Sterilizer Co. Inc. (elec. steam)

BOLTING CLOTH
B. F. Gump Co.

BOOKS—Technical
Andrews Lead Co. Inc.
Glyco Products Co. Inc.
Reinhold Publishing Corp.
D. VanNostrand Co.
B. Westermann Co. Inc.

BOTTLING MACHINERY
Alsop Engineering Co.
American Seitz Filter Co.
Ertel Engineering Corp.
Karl Kiefer Machine Co.
Pneumatic Scale Corp, Ltd.

BRICK—Acid Proof
Custodis Construction Co. Inc. (Zeta, ACO)
Electro Chemical Supply & Engrg. Co.
Maurice A. Knight
Quigley Co.
U. S. Stoneware Co.

BRICK—Insulating
Quigley Co. (Insulbrix)

BRICK—Refractory
Carborundum Co.
Electro Chemical Supply & Engrg. Co.
Norton Co.
Quigley Co.
Titanium Alloy Mfg. Co.

BRICK AND CLAY WORKING MACHINERY
Lancaster Iron Works, Inc.

BRIQUETTING AND TABLET MAKING MACHINERY
Eimer & Amend
Hydraulic Press Mfg. Co.
Read Machinery Co.
Sprout, Waldron & Co.
F. J. Stokes Machine Co.

BUCKETS—Elevator
C. O. Bartlett & Snow Co.
J. H. Day Co., The
Denver Equipment Co. (elevator and conveyor)
Gruendler Crusher & Pulverizer Co.
B. F. Gump Co.
Jeffrey Mfg. Co.
Link-Belt Co. (elevator)
Robinson Mfg. Co.
Sprout Waldron & Co.
Stephens-Adamson Mfg. Co.

BUILDING MATERIALS
Andrews Lead Co. Inc.
Electro Chemical Supply & Engrg. Co.
Pfaltz & Bauer Inc.
Republic Steel Corp.

BURNERS
Philadelphia Drying Mchy. Co. (gas and oil)
Link-Belt Co. (coal)

CABINETS — Chemical, Filing and Laboratory
Kewaunee Mfg. Co.
Laboratory Furniture Co.
Palo-Myers, Inc. (laboratory)
Schwartz Sectional System
E. H. Sheldon & Co.
Storms-Harvey Equip. Co.

CALCINERS
C. O. Bartlett & Snow Co.
Hardinge Co. Inc.

CALORIMETERS
American Meter Co. (sample test for caloric value of gases)
Eimer & Amend
Precision Scientific Co.

CANS
Pittsburgh Steel Drum Co.
Republic Steel Corp.
Storms-Harvey Equip. Co. (stock and mixing)

CARBON
Atlas Powder Co.
Commercial Solvents Corp.
Darco Corp. (activated)
Industrial Chemical Sales Div. West Virginia Pulp & Paper Co.

CARBON BLACKS
Thermatomic Carbon Co.

CARBONIZING EQUIPMENT
Philadelphia Drying Mchy. Co.

CARBOY TILTERS
Barrett-Cravens Co.
Eimer & Amend
Storms-Harvey Equip. Co.

CARS—Tank
American Hard Rubber Co.
Andrews Lead Co. Inc.
Blaw-Knox Co.
J. P. Devine Mfg. Co. Inc.
Ingersoll Steel & Disc Div. Borg-Warner Corp.
National Lead Co.
Struthers Wells

CASTINGS
Andrews Lead Co. Inc.
Antaciron, Inc. (acid resisting, 14½% silicon iron)
Buffalo Foundry & Machine Co. (gray iron and chemical)
Builders Iron Foundry, Inc.
Duriron Co., Inc., The (acid resisting)
Goslin-Birmingham Mfg. Co. (grey iron and iron alloy)
Haveg Corp. (acid and corrosion resistant)
Hills-McCanna Co. (non-ferrous alloys)
International Nickel Co. Inc. (monel & pure nickel)
Henry E. Jacoby (ferrous and non-ferrous)
Link-Belt Co.
Republic Steel Corp.
Robinson Mfg. Co. (grey iron)
T. Shriver & Co. (grey iron, bronze, lead and aluminum)
Sprout, Waldron & Co. (alloy white iron, grey iron)
Worthington Pump & Mchy. Corp. (Worthite)

CAUSTIC POTS
Buffalo Foundry & Machine Co.
Builders Iron Foundry
Eimer & Amend
General Alloys Co.
Goslin-Birmingham Mfg. Co.

CELLULOSE
Hercules Powder Co. (nitro-ethyl acetate)

CEMENT
Bakelite Corp. (adhesive)
Carborundum Co. (refractory)
Custodis Construction Co. Inc. (Penchlor acid proof, Asplit acid resisting)
Electro Chemical Supply & Engrg. Co. (acid proof)
Haveg Corp. (acid proof)
Maurice A. Knight (acid proof)
Norton Co.
Quigley Co. (high temperature, acid proof-chrome)
U. S. Stoneware Co. (acid proof)

CENTRIFUGAL FILTERS
Bird Machine Co.

CENTRIFUGALS
American Tool & Machine Co.
Baker Perkins Co., Inc.
Bird Machine Co. (laboratory)
Eimer & Amend
Fletcher Works, Inc.
Hills-McCanna Co.
Rochester Engrg. & Centrifugal Corp.
Sharples Specialty Co.
Tolhurst Centrifugal Div. American Machine & Metals Co.

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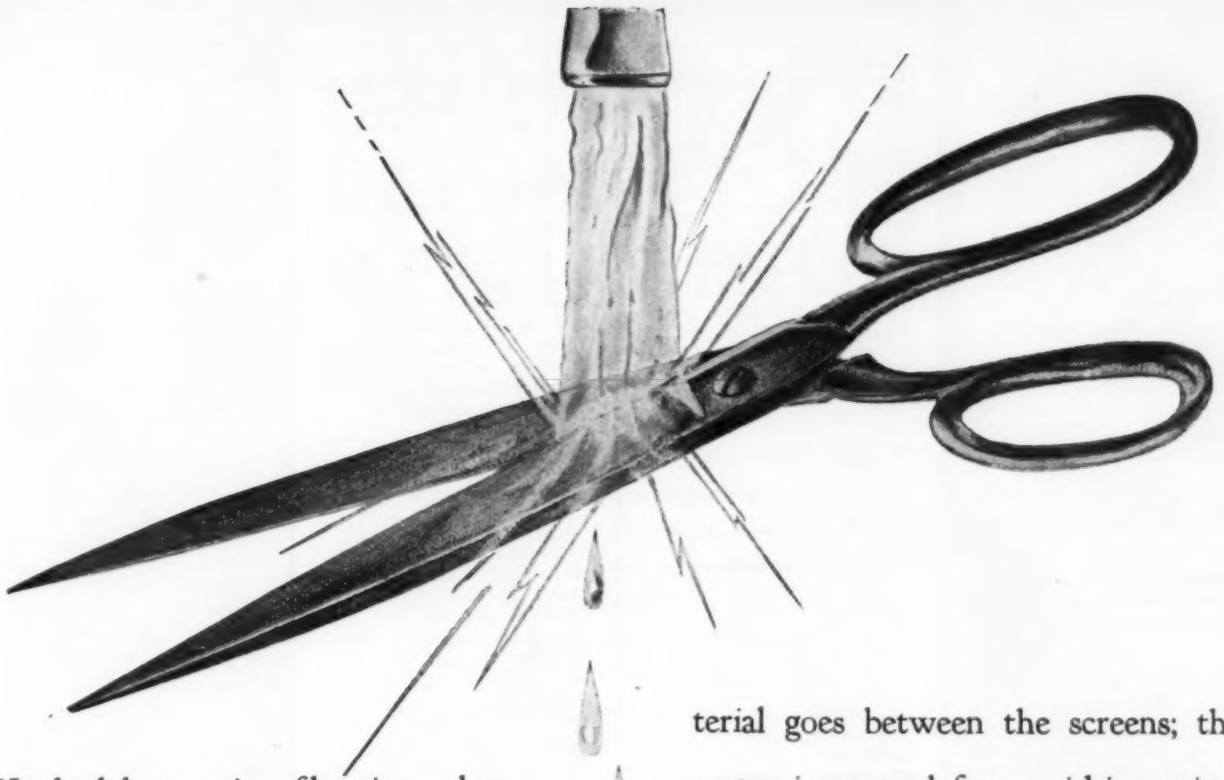
BOOTH 216



He had been using filtration — but filtration used up too much water. He knew centrifuging would use up far less water, but when he tried it, he was unable to build a wall of uniform thickness.

. . . Until he called in A T & M, who designed a special centrifugal with two perforated screens. Now the material goes between the screens; the water is sprayed from within against the inner screen and takes the acid out on the other side.

So building up a uniform wall resulted in a uniformly washed product, and time was saved, and (the same can happen to you, if you have a problem of clarification, dehydration, separation or extraction)—

HIS WATER BILL WAS CUT 50% . . .

THANKS TO AT&M CENTRIFUGING!

Address the American Tool & Machine Company at either 1415 Hyde Park Avenue, Boston, or 30C Church Street, New York, for Bulletin on A T & M Centrifugals for the Process Industries. See us at the *Chem. Show,* Booth 216.

AT&M DESIGN MARCHES AHEAD!

6208

CENTRIFUGES
American Seitz Filter Co. (sieving)
Sharples Specialty Co. (ultra)

CERAMICS
Electro Chemical Supply & Engrg. Co.
Fish-Schurman Corp.
General Ceramics Co.
Kewaunee Mfg. Co.
Norton Co.
Titanium Alloy Mfg. Co.
U. S. Stoneware Co.

CHAINS
Link-Belt Co.

CHARCOAL
Tennessee Eastman Corp.

CHEMICAL & CHEMICAL ENGINEERING SERVICE
Foster D. Snell, Inc.

CHEMICAL PLANT EQUIPMENT
Paul O. Abbe, Inc.
Allegheny Steel Co.
Alsop Engineering Co.
Aluminum Co. of America
American Hard Rubber Co.
American Seitz Filter Co.
Amersil Co., Inc.
Andrews Lead Co.
Antaciron, Inc.
C. O. Bartlett & Snow Co.
J. Bishop & Co. Platinum Works (catalysts, etc.)
Blaw-Knox Co
Bowen Research Corp
Buffalo Foundry & Machine Co.
Builders Iron Foundry
J. H. Day Co., The
J. P. Devine Mfg. Co. Inc.
Dorr Co., Inc., The
Duriron Co., Inc., The
Eimer & Amend
Electro Chemical Supply & Engrg. Co.
Eppenbach, Inc.
Ertel Engineering Corp.
Fansteel Metallurgical Corp.
Fish-Schurman Corp.
General Ceramics Co.
Goslin-Birmingham Mfg. Co.
B. F. Gump Co.
Hardinge Co. Inc.
Haveg Corp.
Hills-McCanna Co.
Hoke, Inc. (small needle valves of brass, chemically resistant alloys, oxygen gas torches)
Henry E. Jacoby
Kewaunee Mfg. Co.
Maurice A. Knight
Korb-Pettit Wire Fabrics & Iron Works
Laboratory Furniture Co.
LaBour Co., Inc.
Lead Lined Iron Pipe Co.
Monarch Mfg. Works, Inc.
National Technical Laboratories
New England Tank & Tower Co.
Norton Co.
Pfaudler Co.
Reeves Pulley Co. of N. Y. Inc.
Robinson Mfg. Co.
Read Machinery Co.
Reinhold Publishing Corp.
Rochester Engrg. & Centrifugal Corp.
Claude S. Schneible Co.
T. Shriver & Co.
Sowers Mfg. Co.
Sprout, Waldron & Co.
F. J. Stokes Machine Co.
Storms-Harvey Equip. Co.
Struthers-Wells
Swenson Evaporator Co.
Taylor Instrument Cos.
U. S. Stoneware Co.
Westinghouse Elec. & Mfg. Co.
Westvaco Chlorine Products Co.
Worthington Pump & Machy. Corp.

CHEMICAL STONEWARE—Acid Proof
Amersil Co., Inc.
Bradley Washfountain Co.
Eimer & Amend
Electro Chemical Supply & Engrg. Co.
Fish-Schurman Corp.
General Ceramics Co.
Kewaunee Mfg. Co.
Maurice A. Knight
Laboratory Furniture Co.
Scientific Glass Apparatus Co.
H. H. Sheldon & Co.
U. S. Stoneware Co.

CHEMICALS—Industrial
Alumium Co. of America
Atlas Powder Co.
Chemical Industries
Commercial Solvents Corp.
Eimer & Amend
Electro Bleaching Gas Co.
Electro Chemical Supply & Engrg. Co.
Glyco Products Co., Inc.
W. A. Hammond Drierite Co. (calcium sulfate, anhydrous drying agents)
Hercules Powder Co. (textiles, paper makers)
Industrial Chemical Sales Div. West Virginia Pulp & Paper Co.
Niagara Alkali Co.
Pfaltz & Bauer Inc.
Charles Pfizer & Co.
Philadelphia Quartz Co.
Allen E. Rogers Laboratories, Inc.
Sharples Solvents Corp.
Titanium Alloy Mfg. Co.
U. S. Industrial Alcohol Co. (dyestuff intermediates)
U. S. Industrial Chemical Co. (dyestuff intermediates)
Westvaco Chlorine Products Co.
Wishnick Tumpeer, Inc.

CHEMICALS—Laboratory
Chemical Industries
Eimer & Amend
Glyco Products Co., Inc.
N. J. Laboratory Supply Co.
Pfaltz & Bauer, Inc.
Charles Pfizer & Co. Inc.
Allen E. Rogers Laboratories, Inc.
Scientific Glass Apparatus Co.
U. S. Industrial Alcohol Co.
U. S. Industrial Chemical Co.

CHEMICALS—Rare
Allen E. Rogers Laboratories, Inc.

CHEMISTS
Foster D. Snell, Inc. (consulting, research)
Pease Laboratories Inc. (analytical, consulting and bacteriologists, research and scientific, industrial)

CHLORINATORS
Blaw-Knox Co.

CLARIFIERS
American Seitz Filter Co.
Baker Perkins Co. Inc.
Bird Machine Co.
Dorr Co., Inc., The
Fletcher Works, Inc.
Hardinge Co. Inc.
Johns-Manville
Rochester Engrg. & Centrifugal Corp.
Sharples Specialty Co.

CLASSIFIERS
Denver Equipment Co.
Federal Pneumatic Systems, Inc. (air)
Hardinge Co. Inc.
Link-Belt Co.

CLEANING MACHINES
Pneumatic Scale Corp. Ltd. (bottle)

CLEANING COMPOUNDS
Philadelphia Quartz Co.

CLUTCHES
Dings Magnetic Separator Co. (magnetic)
Foote Bros. Gear & Machine Corp. (friction)
Kinney Mfg. Co.
Link-Belt Co.

COAL HANDLING MACHINERY
Link-Belt Co.

COAL TAR PRODUCTS
Neville Co.

COATINGS
Quigley Co. (protective-triple for metal, concrete, stucco, wood, etc.)

COCKS
Duriron Co., Inc., The (plug, plain, lubricated, "plunger release" and bib)
Haveg Corp. (acid proof, chemical)
National Lead Co. (plug)

COILS
Lead Lined Iron Pipe Co. ("Wakefield Amalgamated" lead or tin, lined or covered, copper or steel)
National Lead Co. (homogenous lead covered heating or cooling)
U. S. Stoneware Co. (cooling)

COKE OVEN MACHINERY
Goslin-Birmingham Mfg. Co.
Williams Patent Crusher & Pulverizer Co.

COLLECTORS
Bowen Research Corp.
Federal Pneumatic Systems, Inc. (dust)
Gruendler Crusher & Pulverizer Co. (cyclone)
Pangborn Corp.
Robinson Mfg. Co.
Sprout, Waldron & Co.

COLLOID MILLS
Chemicolloid Laboratories, Inc.
J. H. Day Co., The
Eimer & Amend
Eppenbach, Inc.
Manton-Gaulin Mfg. Co
Premier Mill Corp.

COLORIMETERS
Eastern Engrg. Co.
Hellige, Inc. (water testing, varnish, plating solutions, medical, soil testing and vacuum tube galvanometers)
E. Leitz, Inc.
Palo-Myers, Inc.

COLORS—Dry
Pfaltz & Bauer Inc.
Titanium Alloy Mfg. Co.
Wishnick-Tumpeer, Inc.

COLUMNS
Haveg Corp. (absorbing, fractionating, rectifying)

COMPRESSORS
Abbe Engrg. Co.
Beach-Russ Co.
Eimer & Amend
Fuller Co. (air & gas)
Nash Engineering Co.
Worthington Pump & Mchy. Corp.

CONCENTRATORS
Haveg Corp. (acid-chemical)
National Lead Co. (vacuum for acids)

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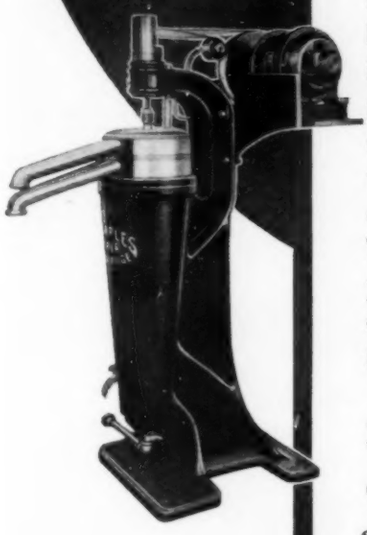
BOOTHS 59, 26A

INDUSTRY LEANS HEAVILY ON THE SUPER CENTRIFUGE

If the use of centrifugal force were suddenly denied industry, hundreds of processes would be crippled—many, in fact, could not exist at all. Since the Sharples Super Centrifuge was first introduced to the chemical field, over 500 different processes have been developed and profitably carried on through the application of Super Centrifugal Force.

Wherever the answer to a seemingly impossible problem can be found through clarification, separation or dehydration, the Sharples Super Centrifuge can usually be counted upon to handle the job. If you are trying to improve an old process or develop a new one—if you want to replace costly or unsatisfactory methods or failure with definite success—we invite you to consult Sharples Centrifugal Engineers. The Super Centrifuge may prove to be your immediate "short cut" to higher quality, uniform production and minimized costs.

Our research laboratories are at your disposal.



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THE SHARPLES SPECIALTY COMPANY
2318 Westmoreland St., Phila., Pa.

SHARPLES

Centrifugal Engineers

HIGHEST CENTRIFUGAL FORCE COMMERCIALLY AVAILABLE

CONDENSERS
Andrews Lead Co. Inc.
Blaw-Knox Co.
Duriron Co. Inc., The
Fansteel Metallurgical Corp.
Fish-Schurman Corp.
General Ceramics Co.
Goslin-Birmingham Mfg. Co.
Haveg Corp. (acid, chemical)
Henry E. Jacoby
Claude B. Schneible Co.
Scientific Glass Apparatus Co. (glass)
F. J. Stokes Machine Co.
Struthers-Wells
Worthington Pump & Mchy. Corp.

CONDITIONING EQUIPMENT
Philadelphia Drying Mchy. Co.

CONNECTIONS
National Lead Co. (tanks—lead & tin lined)

CONTACTS
P. R. Mallory & Co. (tungsten, silver, platinum, special alloys)

CONTACTORS
Blaw-Knox Co.
P. R. Mallory & Co. Inc.
Sharples Specialty Co.
Westinghouse Elec. & Mfg. Co.
Rowan Controller Co.

CONTAINERS
Allegheny Steel Co.
Carpenter Container Co.
Container Co., The
Duriron Co., Inc., The (acid resisting)
Ingersoll Steel & Disc. Div. Borg-Warner Corp.
Paper Service Co.
Pittsburgh Steel Drum Co.
Pressed Steel Tank Co.
Republic Steel Corp.
Stevens Metal Products Co. (stainless steel & stainless clad)
U. S. Stoneware Co.
Wheeling Corrugating Co. Steel Shipping Container Div. (Metal)

CONTROLLERS
American Meter Co. (for rate and volume of flows)
Bailey Meter Co. (air operated)
Bristol Co.
Brown Instrument Co. (automatic for regulating speed, flow and liquid level)
Builders Iron Foundry
Foxboro Co. (temperature, pressure, flow, humidity, liquid level)
Gruendler Crusher & Pulverizer Co. (automatic feed)
Illinois Testing Laboratories, Inc. (indicating pyrometer type)
Mine Safety Appliances Co. (gas analysis, carbon monoxide, combustible gas)
National Technical Laboratories (hydrogen ion)
Reeves Pulley Co. of N. Y. Inc. (variable speed)
Sarco Company, Inc. (temperature)
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos. (temperature, pressure, flow and level, Fulscope and Micromax)
Westinghouse Elec. & Mfg. Co. (electric)

CONVEYING MACHINERY AND EQUIPMENT
Acme Steel Co. (steel belts)
Alsop Engineering Co.
American Machine & Fdry. Co.
C. O. Bartlett & Snow Co.
Builders Iron Foundry
J. H. Day Co., The
Fuller Co. (pneumatic)
Gruendler Crusher & Pulverizer Co.
B. F. Gump Co.
Jeffrey Mfg. Co.
Karl Kiefer Machine Co.
Korb-Pettit Wire Fabric & Iron Works
Lancaster Iron Works, Inc.
Link-Belt Co. (belt, screw conveyor and accessories)
Philadelphia Drying Mchy. Co.
Read Machinery Co.
Reeves Pulley Co. of N. Y., Inc.
John A. Roebling's Sons Co.
Robinson Mfg. Co.
Sprout, Waldron & Co.
Stephens, Adamson Mfg. Co.
Syntron Co.

CONVEYORS
Acme Steel Co. (steel belts)
Denver Equipment Co. (belt, bucket)
Hardinge Co. Inc. (rotary tubular)
Sprout, Waldron & Co. (belt)
Stephens-Adamson Mfg. Co. (elevator, belt, carriers or idlers)

COOLERS
Andrews Lead Co., Inc.
Duriron Co., Inc., The (acid resisting)
Denver Equipment Co. (water)
General Ceramics Co.
Goslin-Birmingham Mfg. Co.
Hardinge Co. Inc.
Haveg Corp. (acid)
Hersey Mfg. Co.
Henry E. Jacoby
Maurice A. Knight
Link-Belt Co.
National Lead Co. (vacuum for acid solution)
Robinson Mfg. Co.
Sprout, Waldron & Co.
Swenson Evaporator Co.
Syntron Co.
Worthington Pump & Mchy. Corp.

COOPERAGE
Acme Steel Co. (hoops)
C. O. Bartlett & Snow Co.
Ingersoll Steel & Disc Div. Borg-Warner Corp.

COSMETICS
Glyco Products Co. Inc. (colors, cream bases, chemicals)
Industrial Chemical Sales Div.—West Virginia Pulp & Paper Co. (precipitated chalk, face powder base, deodorizing materials)

COUPLINGS
Dings Magnetic Separator Co. (magnetic)
Foote Bros. Gear & Mach. Corp. (flexible)
Gruendler Crusher & Pulverizer Co. (flexible)
Kinney Mfg. Co. (cut off, flexible)
Lead Lined Iron Pipe Co.
Link-Belt Co.
Parker Appliance Co.
Sprout, Waldron & Co.
U. S. Stoneware Co.
Worthington Pump & Mchy. Corp.

CRANES
Barrett-Cravens Co.
Link-Belt Co.
Yale & Towne Mfg. Co., Philadelphia Div.

CRUCIBLES
Amersil Co., Inc.
Baker & Co., Inc.
J. Bishop & Co. Platinum Works (platinum lab.)
Carborundum Co.
Eimer & Amend
Fish-Schurman Corp.
Norton Co.
Titanium Alloy Mfg. Co.

CRUSHERS, GRINDERS AND PULVERIZERS
Paul O. Abbe, Inc.
C. O. Bartlett & Snow Co.
J. H. Day Co., The
Denver Equipment Co. (jaw)
Eimer & Amend
Eppenbach, Inc.
Gruendler Crusher & Pulverizer Co.
Hardinge Co., Inc.
Hurricane Pulverizer Co.
Henry E. Jacoby
Jeffrey Mfg. Co.
Lancaster Iron Works, Inc.
Link-Belt Co. (coal, ice and coke)
Pulverizing Machinery Co.
Raymond Pulverizer Div. Combustion Engrg. Co.
Sprout, Waldron & Co.
Robinson Mfg. Co.
Stephens-Adamson Mfg. Co.
Storms-Harvey Equip. Co.
Williams Patent Crusher & Pulverizer Co.

CRYSTALLIZING EQUIPMENT
J. P. Devine Mfg. Co. Inc.
Goslin Birmingham Mfg. Co.
National Lead Co. (vacuum for acid solutions)
Pfaudler Co.
Robinson Mfg. Co.
Sprout, Waldron & Co.
F. J. Stokes Machine Co.
Struthers-Wells
Swenson Evaporator Co.

CUTTERS
Paul O. Abbe, Inc.
Sprout, Waldron & Co. (knife, rotary)

CYLINDERS FOR HIGH PRESSURE GASES
J. P. Devine Mfg. Co., Inc.
Pressed Steel Tank Co.

CO_2 RECORDERS
Brown Instrument Co.
Eimer & Amend
Foxboro Co.
C. J. Tagliabue Mfg. Co.

DECOLORIZATION AND PURIFYING MATERIALS
American Seitz Filter Co.
Atlas Powder Co.
Darco Corp.
Eimer & Amend
Industrial Chemical Sales Div. West Virginia Pulp & Paper Co.

DECORTICATING EQUIPMENT
Sprout, Waldron & Co.

DEFIBERIZING EQUIPMENT
Sprout, Waldron & Co.

DETERGENTS
Philadelphia Quartz Co.
Quigley Co. (annite)

DEVULCANIZERS
Blaw-Knox Co.

DEWATERERS
Denver Equipment Co. (continuous rotary)

DIAPHRAGMS
Carborundum Co. (electrolytic)
Corning Glass Works—Fibre Products Div. (glass fibre)

DIGESTERS
Blaw-Knox Co.
National Lead Co. (homogeneous lead lined)

DISPERSERS
Eppenbach, Inc.

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No responsibility assumed for errors or omissions

DISSOLVERS
Commercial Solvents Corp.
J. H. Day Co., The
Duriron Co., Inc., The (acid resisting)
General Ceramics Co.
Hardinge Co. Inc.
New England Tank & Tower Co.
Robinson Mfg. Co.
Turbo Mixer Corp.

DISTILLING MACHINERY & APPARATUS
Aluminum Co. of America
Amersil Co. Inc.
Barnstead Still and Sterilizer Co. Inc.
Blaw-Knox Co.
J. P. Devine Mfg. Co., Inc.
Duriron Co. Inc., The (acid resisting)
Eimer & Amend
General Ceramics Co.
Henry E. Jacoby
Pfaudler Co.
Robinson Mfg. Co.
Scientific Glass Apparatus Co.
Sprout, Waldron & Co.
F. J. Stokes Machine Co.
Struthers-Wells
Taylor Instrument Cos.

DRINKING FOUNTAINS
Bradley Washfountain Co.

DRIVES
Denver Equipment Co.
Link-Belt Co. (chain)
Storms-Harvey Equipment Co. (chain)

DRUMS
Carpenter Container Co. (fibre, shipping)
Dings Magnetic Separator Co. (magnetic)
National Lead Co. (treater)
Swenson Evaporator Co.

DRUMS—Rotary—Vacuum
Blaw-Knox Co.
Buffalo Foundry & Machine Co.
J. H. Day Co., The
J. P. Devine Mfg. Co., Inc.
Hardinge Co. Inc.
Hersey Mfg. Co. (rotary)
F. J. Stokes Machine Co.

DRYERS
W. A. Hammond Drierite Co. (balance, gas, tray, compartment, Drierite—Du-cal Drierite, Indicating Drierite)
Sharples Specialty Co. (vacuum)

DRYERS—Centrifugal
American Machine & Foundry Co.
Baker Perkins Co. Inc.
Bird Machine Co.
Blaw-Knox Co.
Bowen Research Corp. (spray)
Eimer & Amend
Fletcher Works, Inc.
Rochester Engrg. & Centrifugal Corp.
Sharples Specialty Co.
Tolhurst Centrifugal Div., American Machine & Metals Co. (metal)

DRYING MACHINERY AND EQUIPMENT
American Machine & Fdry. Co.
C. O. Bartlett & Snow Co.
Blaw-Knox Co.
Buffalo Foundry & Machine Co.
J. H. Day Co., The
J. P. Devine Mfg. Co., Inc.
Denver Equipment Co. (rotary, indirect, steam)
Hardinge Co. Inc.
Hersey Mfg. Co.
W. A. Hammond Drierite Co.
Ingersoll Steel & Disc Div. Borg-Warner Corp.
Jeffrey Mfg. Co.
Korb-Pettit Wire Fabrics & Iron Works
Lancaster Iron Works, Inc.
Link Belt Co.
Oliver United Filters Inc. (D. L. O. Dryer)
Philadelphia Drying Mchy. Co.
Proctor & Schwartz, Inc.
Raymond Pulverizer Div., Combustion Engrg. Corp.
Reeves Pulley Co. of N. Y. Inc.
Rochester Engrg. & Centrifugal Corp.
John A. Roebling's Sons Co.
F. J. Stokes Machine Co.
Struthers-Wells
W. S. Tyler Co.

DUST COLLECTING SYSTEMS
C. O. Bartlett & Snow Co.
Corning Glass Works—Fibre Products Div. (glass bags for)
Federal Pneumatic Systems, Inc.
Pangborn Corp.
Raymond Pulverizer Div., Combustion Engrg. Corp.
Robinson Mfg. Co.
Claude B. Schneible Co.
Sprout, Waldron & Co.
Westinghouse Elec. & Mfg. Co.
Williams Patent Crusher & Pulverizer Co.

DUST & SPRAY MASKS
Mine Safety Appliances Co.
Pangborn Corp.

DYES
Eastern Engrg. Co. (for pearl products)
Eimer & Amend

DYESTUFF INTERMEDIATES
U. S. Industrial Alcohol Co.
U. S. Industrial Chemical Co.

EJECTORS
Duriron Co. Inc., The
Haveg Corp. (acid)
Nash Engineering Co. (sewage)
Worthington Pump & Mchy. Corp. (steam jet, vacuum)

ELECTRICAL EQUIPMENT AND SUPPLIES
Baker & Co., Inc. (contacts)
Corning Glass Works—Fibre Products Div. (glass insulating tape)
General Electric Co.
General Electric Vapor Lamp Co.
Westinghouse Elec. & Mfg. Co. (lighting panel boards, oil immersed)

ELECTRODES
P. R. Mallory & Co. (resistance welding)

ELECTROLYTIC CELLS
Westvaco Chlorine Products Co.

ELEVATORS
American Machine & Fdry. Co.
Barrett-Cravens Co. (portable)
C. O. Bartlett & Snow Co.
J. H. Day Co., The
Denver Equipment Co. (mine cage)
Economy Engineering Co.
Gruendler Crusher & Pulverizer Co. (bucket)
B. F. Gump Co.
Lewis-Shepard Co. (portable)
Link-Belt Co.
Robinson Mfg. Co.
Sprout, Waldron & Co.
Stephens-Adamson Mfg. Co.
Storms-Harvey Equip. Co. (portable)
Westinghouse Elec. & Mfg. Co.

EMULSIFIERS
Denver Equipment Co.
Eppenbach, Inc.
Sprout, Waldron & Co.

ENAMELED APPARATUS
Ertel Engineering Corp.
Henry E. Jacoby (filter press plates and frames)
Hills-McCanna Co. (valves)
Pfaudler Co. (glass)

ENAMELS
Bakelite Corp.
Electro Chemical Supply & Engrg. Co.

ENGINES
Worthington Pump & Mchy. Corp.

ENGINEERS
Denver Equipment Co. (construction and design of plants)
Foster D. Snell, Inc. (chemical)

EVAPORATORS
Blaw-Knox Co.
Buffalo Foundry & Machine Co.
J. P. Devine Mfg. Co., Inc.
Duriron Co. Inc., The (acid resisting dishes and pans)
Goslin-Birmingham Mfg. Co.
Haveg Corp. (chemical)
Ingersoll Steel & Disc Div. Borg Warner Corp.
Henry E. Jacoby
National Lead Co. (homogeneous lead lined, vacuum)
Pfaudler Co.
F. J. Stokes Machine Co.
Struthers-Wells
Swenson Evaporator Co.

EXHAUSTERS
American Hard Rubber Co.
Antaciron, Inc. (for acid fumes)
Duriron Co. Inc., The (acid resisting)
General Ceramics Co.
Haveg Corp. (acid)
Pangborn Corp.
U. S. Stoneware Co.
Worthington Pump & Mchy. Corp.

EXPERIMENTAL APPARATUS
Precision Scientific Co.

EXPLOSIVES
Atlas Powder Co.
Hercules Powder Co.

EXTRACTION PLANTS
Barnstead Still & Sterilizer Co. Inc.
C. O. Bartlett & Snow Co.
Bird Machine Co.
Blaw-Knox Co.
Fish-Schurman Corp.
Goslin-Birmingham Mfg. Co.
Henry E. Jacoby
F. J. Stokes Machine Co.
Struthers-Wells

EXTRACTORS
Barnstead Still & Sterilizer Co. Inc. (Soxhlet)
Bird Machine Co. (laundry, textile)

FABRICATING
Korb-Pettit Wire Fabrics & Iron Works (wire and metal to specifications, spiral weave, steel and stainless steel)

FADE-OMETER
Atlas Electric Devices Co. (accelerated sunlight)

FANS
Duriron Co. Inc., The (exhaust)
Haveg Corp. (exhaust, acid)

FATS AND FATTY ACIDS
Glyco Products Co. Inc.
Industrial Chemical Sales Div., West Virginia Pulp & Paper Co.
Wishnick-Tumpeer, Inc.

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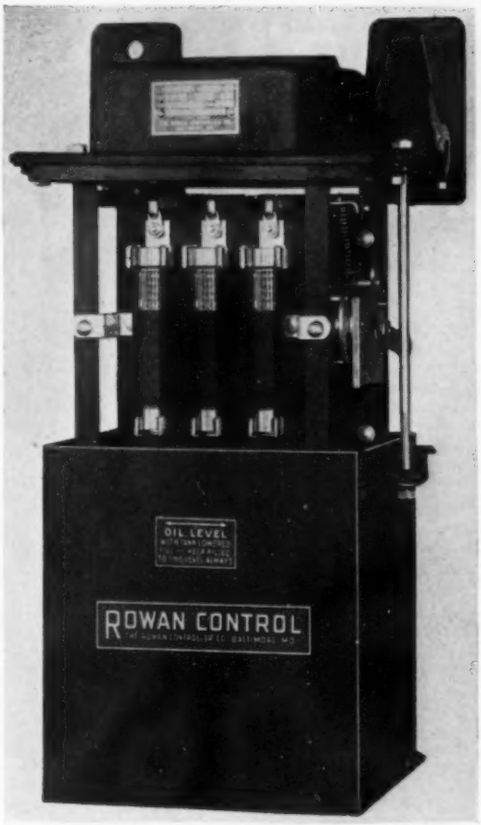


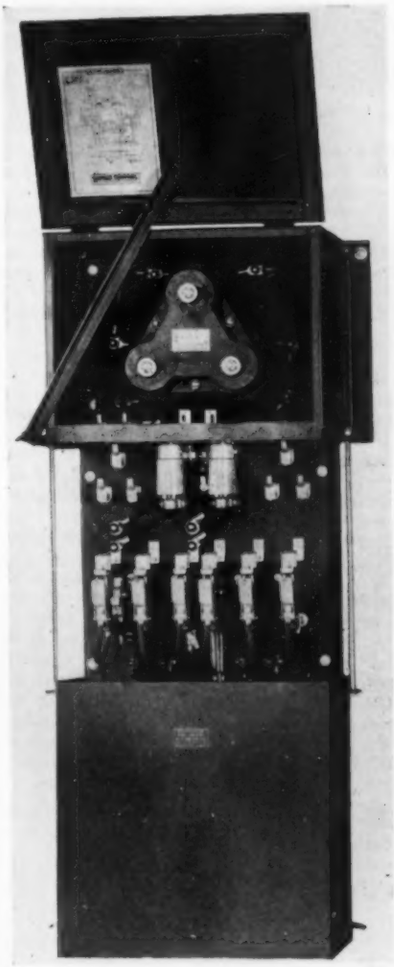
A MATCHED SET *for* *Best Performance*

A golfer uses a matched set of clubs for better control of his game.

The wise chemical man uses matched control units for better control of his operations.

Here are the units of a "perfectly matched set" of Rowan Oil Immersed Control Equipment.

Type 620-A completely oil immersed, fused, safety disconnect switch (left) is dust tight, free from corrosion, ruggedly constructed and thoroughly dependable. Type 900-B reduced voltage impedance starter (right) has all operating parts completely oil immersed, dust tight construction, smooth acceleration, simplicity of design and is of exceptionally rugged construction.



This combination of Rowan Oil Immersed Control Equipment provides the chemical man with the perfectly "matched set" for best performance.

Memo— A personal invitation is extended to you to visit Booth #512

Illustrated bulletins containing complete information with prices are available and will be furnished promptly upon request.

ROWAN CONTROL
THE ROWAN CONTROLLER CO., BALTIMORE, MD.

FEEDERS
Denver Equipment Co. (apron and plate, automatic, dry chemical, liquid, plunger, reagent, table)
Federal Pneumatic Systems, Inc.
Fuller Co. (for pulverized, fine, crushed and granular materials)
B. F. Gump Co. (chemical, percentage)
Hardinge Co. Inc. (volumetric and weighing)
Link-Belt Co.
Sprout, Waldron & Co. (percentage and rotary)
Stephens-Adamson Mfg. Co. (for regulating volume of material handled by conveyors, screens, crushers)

FILLERS
Dicalite Co. (paper, rubber, plastics, polishes, pigmented plastics and paint, catalyst carrier, insecticide carrier)

FILLING MACHINES
Alsop Engineering Co.
American Seitz Filter Co.
Ertel Engineering Corp.
B. F. Gump Co. (packers for bag and barrel and small containers)
Karl Kiefer Machine Co.
Pneumatic Scale Corp.
St. Regis Paper Co.
Sprout, Waldron & Co.
F. J. Stokes Machine Co.
Stokes & Smith Co.
Syntron Co.

FILTER AIDS
Alsop Engineering Co.
American Seitz Filter Co.
H. Reeve Angel & Co. Inc.
Dicalite Co.
Fish-Schurman Corp.
Johns-Manville
Palo-Myers, Inc.
Pfaltz & Bauer Inc.

FILTER CLOTH
American Seitz Filter Co.
Corning Glass Works—Fibre Products Div. (glass)
Eimer & Amend
Filter Media Co. (woven glass)
Henry E. Jacoby
Korb-Pettit Wire Fabrics & Iron Works
John A. Roebling's Sons Co.
T. Shriver & Co.
W. S. Tyler Co.

FILTER CLOTH—Metallic
American Seitz Filter Co.
Eimer & Amend
International Nickel Co. Inc.
Korb-Pettit Wire Fabrics & Iron Works
Newark Wire Cloth Co.
Oliver United Filters Inc. (Sweetland Patent Metallic)
John A. Roebling's Sons Co.
W. S. Tyler Co.

FILTER MASS
H. Reeve Angel & Co. Inc.

FILTER PAPER
Alsop Engineering Co.
American Seitz Filter Co.
H. Reeve Angel & Co. Inc.
Eimer & Amend
Henry E. Jacoby
Karl Kiefer Machine Co.
Palo-Myers, Inc.
Scientific Glass Apparatus Co.
T. Shriver & Co.

FILTERS
Alsop Engineering Co.
Aluminum Co. of America
American Meter Co. (to protect gas meters and regulators)
American Seitz Filter Co. (pressure leaf, for asbestos and filtercell filtration—sheet filters for clarifying and sterilizing of liquids)
Bird Machine Co. (centrifugal)
Cuno Engineering Corp. (all metal, self cleaning)
Denver Equipment Co. (presses, hydraulic, continous rotary, laboratory, vacuum)
Duriron Co. Inc., The (acid resisting)
Eimer & Amend
Ertel Engineering Corp. (asbestos, disk)
Federal Pneumatic Systems, Inc. (air)
Fish-Schurman Corp. (Jena fretted glass, colored optical and bacteria proof, porous porcelain)
General Ceramics Co.
Goslin-Birmingham Mfg Co. (pressure leaf and vacuum drum, Vallez rotary leaf pressure filter and Ahlquist drum filter)
Henry E. Jacoby (plate and frame filter presses)
Karl Kiefer Machine Co. (cloth, paper, pulp)
Maurice A. Knight (acid proof)
Norton Co. (ceramic)
Oliver United Filters Inc. (pressure, continuous pressure, continous vacuum, clarifying)
Pfaltz & Bauer Inc.
Productive Equipment Corp. (vibrating)
Rochester Engrg. & Centrifugal Corp. (centrifugal)
Claude B. Schneible Co. (air)
T. Shriver & Co. (plate and frame recessed plate, pressure filter in metal or wood)
Swenson Evaporator Co. (rotary vacuum, pressure, clarification, cast lead)
U. S. Stoneware Co. (vacuum)

FIRE CLAY
Quigley Co.

FIRE DETECTION SYSTEMS
Walter Kidde & Co.

FIRE EXTINGUISHERS
Walter Kidde & Co. Inc (fire extinguishing systems, carbon dioxide systems)
Storms-Harvey Equip. Co.

FIRE PROOFING COMPOUNDS
Glyco Products Co. Inc.
Philadelphia Quartz Co.

FITTINGS
Aluminum Co. of America
American Hard Rubber Co.
Andrews Lead Co. Inc. (lead)
Antaciron, Inc. (pipe, acid proof)
Crane Co. (chrome nickel alloy, monel, nickel, aluminum, Everdur, acid bronze, cast and malleable iron, steel, brass)
Duriron Co. Inc., The (acid resisting)
General Alloys Co.
General Ceramics Co.
Haveg Corp. (acid pipe, drainage pipe, tank)
Lead Lined Iron Pipe Co. ("Wakefield Amalgamated" Black and galvanized, lead lined screwed, acid resisting, flanged, pure block tin lined, C. I., M. I., and brass, soil pipe fittings, lead lined)
National Lead Co. (lead lined, hard lead, tin lined)
Parker Appliance Co.

FLOCKING EQUIPMENT
Sprout, Waldron & Co.

FLOORING
Acme Steel Co.
Alberene Stone Corp. of Va.
Blaw-Knox Co.
Custodis Construction Co. Inc. (acid proof masonry)
Electro Chemical Supply & Engrg. Co.
Korb-Pettit Wire Fabrics & Iron Works
Pfaltz & Bauer Inc.
U. S. Stoneware Co.

FOOD INDUSTRIES EQUIPMENT
American Hard Rubber Co.
American Machine & Fdry. Co.
American Seitz Filter Co.
Blaw-Knox Co.
Builders Iron Foundry
Chemicolloid Laboratories, Inc.
Duriron Co. Inc., The
Eastern Engrg. Co. (mixers)
Eppenbach, Inc.
Gruendler Crusher & Pulverizer Co.
B. F. Gump Co.
Ingersoll Steel & Disc Div. Borg-Warner Corp.
Henry E. Jacoby
Kewaunee Mfg. Co.
Laboratory Furniture Co.
Lead Lined Iron Pipe Co.
Pfaudler Co.
Robinson Mfg. Co.
Sharples Specialty Co.
Sprout, Waldron & Co.
T. Shriver & Co.
F. J. Stokes Machine Co.
Stokes & Smith Co.
Swenson Evaporator Co.
Carl Zeiss, Inc.

FUMIGANTS
Commercial Solvents Corp.

FURNACES AND ACCESSORIES
Bowen Research Corp. (oil)
Bristol Co. (furnace controllers)
Denver Equipment Co. (assay)
Fish-Schurman Corp. (porcelain electric)
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Philadelphia Drying Mchy. Co. (annealing, normalizing, stress relieving, hardening, heat treating)
Struthers-Wells (indirect heating)
Taylor Instrument Cos. (temperature control)
Westinghouse Elec. & Mfg. Co. (electric)

GAGES
American Meter Co.
Bailey Meter Co. (draft)
Bristol Co.
Brown Instrument Co. (indicating and recording pressure and vacuum)
Foxboro Co. (pressure, vacuum, liquid level)
Eimer & Amend (vacuum-pressure)
Hoke, Inc. (gas pressure and vacuum)
Matheson Co. (pressure, reducing, vacuum)
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos.

GAS ANALYZERS
Mine Safety Appliances Co. (continuous automatic)

GAS BOOSTERS
Abbe Engrg. Co.
Beach-Russ Co.
Worthington Pump & Mchy. Corp.

GAS PURIFIERS
Blaw-Knox Co.
Claude B. Schneible Co.

GASES
Andrews Lead Co. (litharge)
Electro Bleaching Gas Co.
Matheson Co.
Niagara Alkali Co.

GASKETS
Garlock Packing Co. (rubber, asbestos, Neoprene, Thiokol, semi-metallic, leather)

GATES
Denver Equipment Co. (bin & hopper)
Link-Belt Co.

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Curious, Questioning EYES OF SCIENCE

●Under the searching eyes of science in the Crane laboratories, aided by the latest and most advanced equipment, research engineers are constantly peering into the grain structure of castings and forgings—examining the stresses in valve bodies. Photomicrographs are constantly being made—a permanent record for future reference.

From the first simple chemical analysis, through the more elaborate studies by means of metalographic equipment, Crane Co. has complete control not only of raw material but of every step and every process to the finished product—accurate, dependable knowledge is substituted for guesswork—chance of failure on the job reduced to the minimum.

Probably in no other field are processes more exacting than in the chemical industry. That is why Crane valves and fittings of special alloys, backed by Crane's technical knowledge, are today handling corrosive fluids—mine water—fatty acids—food products—sulphite liquors and vapors, and scores of other products and by-products of chemical, food, paper and tanning plants.

Most valve and fitting problems in the Chemical Industry will find their solution on pages 420-421 of the Crane No. 52 Catalog. In this book are listed 38,000 items which are proving in the laboratories of experience what Crane research engineers have already proved in the laboratories of science.

CRANE

CRANE CO., GENERAL OFFICES: 836 SOUTH MICHIGAN AVENUE, CHICAGO, ILLINOIS

Branches and Sales Offices in One Hundred and Sixty Cities

VALVES, FITTINGS, FABRICATED PIPE, PUMPS, PLUMBING AND HEATING MATERIAL

plied in the next few days.

INFORMATION OF VALUE AT BOOTHS 312-313

Every chemical and metallurgical engineer—every executive, superintendent and foreman interested in Chemical Process Industries will find much of value at the Crane exhibit specifically planned to show the newest developments in control of liquids and gases in these industries.

The exhibit will feature the famous Crane 18-8 chrome-nickel alloy line of gate, globe, angle, check and relief valves, fittings and accessories, flanges and piping in a wide range of standard sizes as well as special valves and fittings in aluminum, monel and pure nickel.

Don't miss this important exhibit at the 16th Exposition of Chemical Industries—December 6 to 11, 1937.

Booths 312-313
GRAND CENTRAL PALACE
NEW YORK

GEARS
Bakelite Corp.
Foote Bros. Gear & Mach. Corp.
Jeffrey Mfg. Co.
Link-Belt Co.
Stephens-Adamson Mfg. Co.
Westinghouse Elec. & Mfg. Co.

GLASS—Optical
Amersil Co. Inc. (quartz)
Bausch & Lomb Optical Co.
Fish-Schurman Corp.

GLASSWARE
Corning Glass Works
Demuth Glass Works (scientific & industrial tubes & rods, chemical of all kinds)
Eimer & Amend
Fish-Schurman Corp.
Kimble Glass Co.
N. J. Laboratory Supply Co.
Palo-Myers, Inc. (laboratory)
Scientific Glass Apparatus Co. (laboratory)

GRANULATORS
Paul O. Abbe, Inc.
Sprout, Waldron & Co.

GRATING
Aluminum Co. of America
Blaw-Knox Co.
Korb-Petitt Wire Fabrics & Iron Works
Pfaltz & Bauer Inc.

HEADS
Black, Sivalls & Bryson, Inc. (rupture, safety)
Haveg Corp. (pipe)

HEAT EXCHANGERS
Blaw-Knox Co.
Corning Glass Works
J. P. Devine Mfg. Co. Inc.
Duriron Co. Inc., The (acid resisting)
Fansteel Metallurgical Corp.
Goslin-Birmingham Mfg. Co.
Henry E. Jacoby
Claude B. Schneible Co.
Struthers-Wells
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mchy. Corp.

HEATING SYSTEMS AND ACCESSORIES
Sarco Company, Inc.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos.

HEATERS
Precision Scientific Co. (laboratory, and hot plates)
Worthington Pump & Machy. Corp. (feed water)

HOISTS
American Machine & Fdry. Co.
Barrett-Cravens Co.
C. O. Bartlett & Snow Co.
Denver Equipment Co. (air, electric, steam)
Jeffrey Mfg. Co.
Lancaster Iron Works
Stephens-Adamson Mfg. Co.
Storms-Harvey Equipment Co.

HOMOGENIZERS
Andrews Lead Co. Inc. (homogeneous bonding)
Bowen Research Corp.
Chemicolloid Laboratories, Inc.
Eimer & Amend
Eppenbach, Inc.
Manton-Gaulin Mfg. Co.
Pfaudler Co.
Robinson Mfg. Co.

HOODS—Fume
Alberene Stone Corp. of Va.
American Hard Rubber Co.
Electro Chemical Supply & Engrg. Co.
Ingersoll Steel & Disc Div., Borg-Warner Corp.
Kewaunee Mfg. Co.
Laboratory Furniture Co.
E. H. Sheldon & Co.

HUMECTANT AGENT
Atlas Powder Co.

HUMIDIFYING APPARATUS
Claude B. Schneible Co.
Taylor Instrument Cos.

HYDROGEN ION
Eimer & Amend
Hellige, Inc.
Hoke, Inc. (hydrogen regulators for PH work)
N. J. Laboratory Supply Co.
National Technical Laboratories.
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Scientific Glass Apparatus Co.
W. A. Taylor & Co.

IMPREGNATING EQUIPMENT
Blaw-Knox Co.
W. A. Hammond Drierite Co. (drying and impregnating)
Struthers-Wells

INDICATORS
American Meter Co. (flow)
Bailey Meter Co.
Builders Iron Foundry
Eimer & Amend
Exact Weight Scale Co.
Foxboro Co. (temperature, pressure, flow, liquid level)
Mine Safety Appliance Co. (gas)
Parker Appliance Co. (flow)
Pfaltz & Bauer Inc.
Reeves Pulley Co. of N. Y. Inc.
Taylor Instrument Cos.
W. A. Taylor & Co.

INSTRUMENTS—Optical
Bausch & Lomb Optical Co.
Eimer & Amend
Fish-Schurman Corp.
Hellige, Inc.
E. Leitz Inc. (panphot combining microscopy observations with photography)
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Carl Zeiss, Inc.

INSTRUMENTS—Testing
American Meter Co. (for gas meters and gas regulators)
Bailey Meter Co.
Fish-Schurman Corp.
Foxboro Co. (pressure gages)
Hellige, Inc.
Mine Safety Appliances Co. (gas analysis)
National Technical Laboratories (oil testing)
N. J. Laboratory Supply Co.
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Precision Scientific Co.
Reeves Pulley Co. of N. Y. Inc.
Seederer-Kohlbusch, Inc.
C. J. Tagliabue Mfg. Co.
W. A. Taylor & Co.
Westinghouse Elec. & Mfg. Co.

INSULATING MATERIAL—Heating, Electric & Molded
American Hard Rubber Co.
Amersil Co. Inc. (electric)
Bakelite Corp.
Corning Glass Works—Fibre Products Div.
Dicalite Co.
Quigley Co. (heating)
Westinghouse Elec. & Mfg. Co.

INSULATION—Furnace
Dicalite Co.
Quigley Co.

INTERFEROMETERS
Carl Zeiss, Inc.

KETTLES
Allegheny Steel Co. (jacketed)
Alsop Engineering Co.
Aluminum Co. of America (steam jacketed)
Andrews Lead Co. Inc. (lead lined)
Antaciron, Inc. (acid proof)
Blaw-Knox Co. (lead, direct fired, jacketed)
Buffalo Foundry & Machine Co. (processing)
J. P. Devine Mfg. Co., Inc.
Duriron Co., Inc., The (acid resisting)
General Ceramics Co.
Goslin-Birmingham Mfg. Co.
Haveg Corp. (acid proof, corrosion resistant alloy, noncorrosive)
Henry E. Jacoby (ferrous and non ferrous, cast and fabricated plate, plain, jacketed, open top, pressure, vacuum)
Ingersoll Steel & Disc. Div., Borg-Warner Corp.
Maurice A. Knight (acid proof)
National Lead Co. (steam jacketed)
Philadelphia Drying Mchy. Co. (Immersion for heating solution)
Sowers Mfg. Co. (Dopp iron and Dopploy seamless jacketed and single shell)
Sprout, Waldron & Co. (fabricated metal)
Storms-Harvey Equip. Co. (jacketed)
Struthers-Wells (mixing)
U. S. Stoneware Co. (acid)

KILNS
C. O. Bartlett & Snow Co. (calcining)
Goslin-Birmingham Mfg. Co. (sugar)
Hardinge Co. Inc. (rotary)
Struthers-Wells (rotary)

LABELING MACHINES
Alsop Engineering Co.
Pneumatic Scale Corp. Ltd.

LABORATORIES—Testing
Atlas Electric Devices Co. (weatherometer, fade-ometer, launderometer)
Dorr Co., Inc., The
Eastern Engineering Co. (thermo-regulators and stirrers with controlled agitation—electroplating solution analysis method)
Federal Pneumatic Systems, Inc.
Newark Wire Cloth Co.
Laboratory Furniture Co.
Allen E. Rogers Laboratories, Inc.

LABORATORY APPARATUS and SUPPLIES
Alberene Stone Corp. of Va. (drain boards, soapstone, table tops)
American Meter Co. (dry and wet test for air and gases, calorimeters, specific gravity apparatus)
American Hard Rubber Co.
Amersil Co. Inc.
Antaciron, Inc.
Atlas Electric Devices Co.
Bausch & Lomb Optical Co.
Baker & Co. Inc.
J. Bishop & Co. Platinum Works (platinum)
Carborundum Co.
Corning Glass Works—Fibre Products Div. (fibre glass filtering medium)
Corning Glass Works
Demuth Glass Works (glassware)
Denver Equipment Co. (steambaths, oilbaths, colorimeters)
Duriron Co. Inc., The
Eastern Engrg. Co. (stirrers, thermo-regulators, water baths, steam baths, oil baths, colorimeters)
Eimer & Amend (of all kinds)
Federal Pneumatic Systems, Inc.
Fish-Schurman Corp.
Garlock Packing Co. (aprons, rubber, acid resistant)
General Ceramics Co.
Hanovia Chemical & Mfg. Co.
Haveg Corp.
Hellige, Inc.
Hoke, Inc. (needle valves, gas pressure reducing valves, oxygen-gas torches for working pyrex and quartz—also for soldering, making alloys)

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STRUTHERS-WELLS

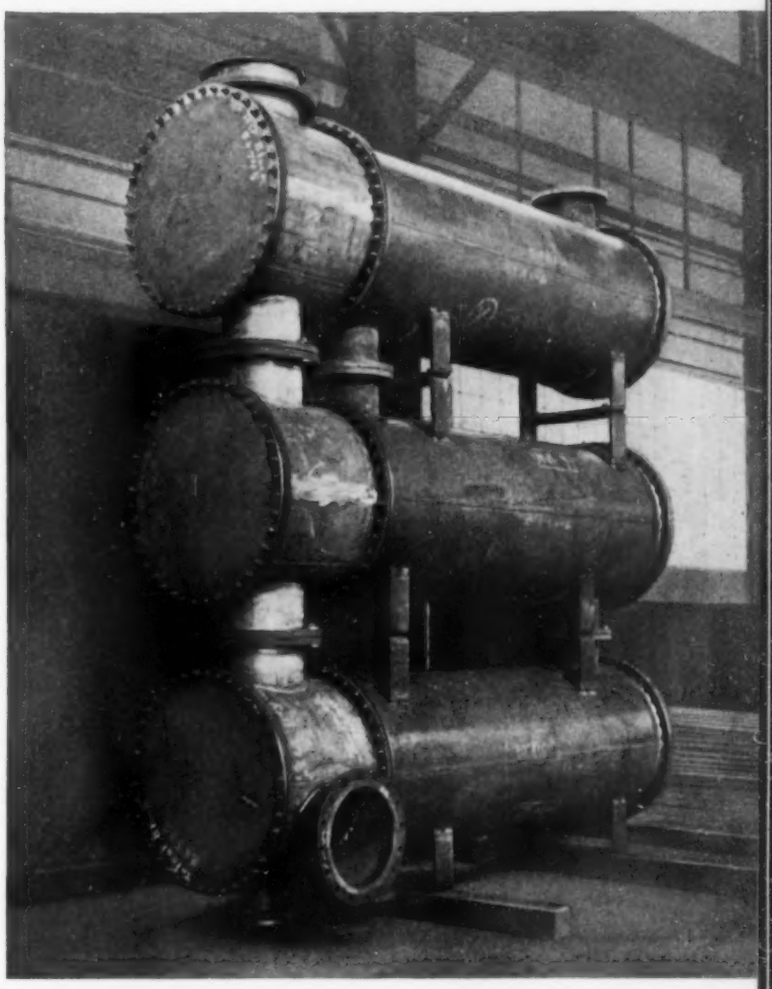
Offers a Complete Line of
HEAT EXCHANGERS

DESIGNED AND FABRICATED TO HIGHEST STANDARDS OF CONSTRUCTION

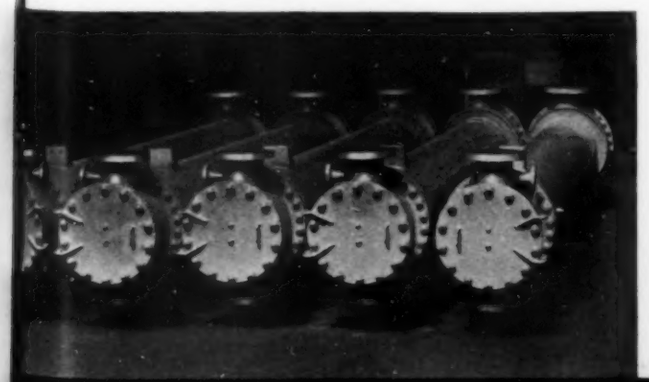
Out of the laboratory of exhaustive Research and Experience comes the Struthers-Wells line of Heat Exchangers, designed by a staff of specialists with many years of experience in meeting the many and varied heat transfer problems of industry.

The facilities of two large shops are available for the fabrication of this equipment, including complete radiographing and annealing. Wide experience in the welding of various types of alloys gives you a choice of exchangers fabricated from any commercial alloy.

Each Struthers-Wells Exchanger is designed for its particular service, taking into account the special heat transfer and economic considerations involved.



Struthers-Wells Gas Interchangers of welded Everdur construction, 38 inches diameter. In service in southern chemical plant.



A group of Struthers-Wells Type F Heaters, special stainless steel tubes and tube sheets, for paper mill service.

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Our Bulletin 76 contains valuable heat transfer data of interest to every chemical engineer.

STRUTHERS-WELLS

DIVISION OF STRUTHERS-WELLS—TITUSVILLE CORPORATION

WARREN, PENNA.

PLANTS AT WARREN, PENNSYLVANIA AND TITUSVILLE, PENNSYLVANIA, ALSO
TITUSVILLE IRON WORKS COMPANY · TITUSVILLE FORGE COMPANY

Kimble Glass Co. (biological, chemical and metallurgical glassware, graduated and ungraduated glass tubing and rods—small containers, vials, ampoules, serum vials)
Lancaster Iron Works, Inc.
N. J. Laboratory Supply Co.
Norton Co.
Newark Scale Works
Oliver United Filters Inc. (all types filters)
Palo-Myers, Inc.
Pfaltz & Bauer Inc.
Pfaudler Co.
Precision Scentific Co. (experimental, incubators, stirrers)
Philadelphia Drying Mchy. Co.
Scientific Glass Apparatus Co.
Sharples Specialty Co.
Sprout, Waldron & Co.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos.
W. S. Tyler Co.
U. S. Stoneware Co.
Carl Zeiss, Inc.

LABORATORY FURNITURE
Alberene Stone Corp. of Va. (drainboards, soapstone, table tops)
Denver Equipment Co. (tables)
Eimer & Amend
General Ceramics Co.
Kewaunee Mfg. Co. (automatic adjustable stools and chairs)
Laboratory Furniture Co.
Leonard Peterson & Co. Inc.
Schwartz Sectional System
E. H. Sheldon & Co.

LACQUERS
Dicalite Co. (flattening agents)

LAMPS
Allegheny Steel Co.
Atlas Electric Devices Co. (arc)
Eimer & Amend
General Electric Vapor Lamp Co. (neon glow, indicators and pilots, Uyiarc mercury vapor)
Hanovia Chemical & Mfg. Co.
Storms-Harvey Equip. Co. (sunlike)
Westinghouse Elec. & Mfg. Co.

LAUNDER-OMETERS
Atlas Electric Devices Co. (accelerated washing)

LEAD BURNING AND COATING
Andrews Lead Co. Inc.
Hoke, Inc. (torches for)
Henry E. Jacoby
Lead Lined Iron Pipe Co.

LIGHTING EQUIPMENT
General Electric Vapor Lamp Co.
Westinghouse Elec. & Mfg. Co.

LIME—Chemical and Hydrated
Eimer & Amend
Warner Co., Bellefonte Div.

LIMESTONE
Warner Co., Bellefonte Div. (in all sizes)

LININGS
Custodis Construction Co. Inc. (acid proof tank)
Maurice A. Knight (acid proof tank)
Paper Service Co. (vapor and waterproof)
U. S. Stoneware Co. (tank)

LOADERS
Jeffrey Mfg. Co.
Link-Belt Co. (box car)
Sprout, Waldron & Co.
Stephens, Adamson Mfg. Co. (box car)

LUBRICATORS
Hills McCanna Co. (mechanical force feed)

MAGNETIC SEPARATORS
Dings Magnetic Separator Co.
S. G. Frantz & Co.
Robinson Mfg. Co.
Sprout, Waldron & Co.
Sutton, Steele & Steele, Inc.

MASTICATORS
J. H. Day Co., The

MATERIALS HANDLING EQUIPMENT
Barrett-Cravens Co. (drain racks, barrel and drum racks, lift trucks, skids, barrel trucks)
C. O. Bartlett & Snow Co.
Blaw-Knox Co.
J. H. Day Co., The
Denver Equipment Co. (industrial cars)
Duriron Co. Inc., The
Economy Engineering Co. (barrel racks and barrel stands, red rockers)
Gruendler Crusher & Pulverizer Co.
Jeffrey Mfg. Co.
Korb-Pettit Wire Fabrics & Iron Works (trays, belts)
Lancaster Iron Works, Inc.
Lewis-Shepard Co. (industrial and lift trucks, floor and warehouse skid platforms)
Link-Belt Co. (ash handling, dock loading and unloading)
Read Machinery Co.
Reeves Pulley Co. of N. Y.
Sabin Machine Co.
Robinson Mfg. Co.
Sprout, Waldron & Co.
Stephens, Adamson Mfg. Co. (winches, hand and motor drives)
Storms-Harvey Equip. Co. (steel shelving, factory hand trucks, barrel and drum stands)
Syntron Co. (vibrators, feeder conveyors, weigh feeders, gravimetric feeders, vibrating cooler conveyors, gross and net batch weighing)
Worthington Pump & Mchy. Corp.
Yale & Towne Mfg. Co., Phila. Div. (elec. industrial trucks, hand lift trucks, skid platforms, trolleys, elec. hoists)

MERCURY VAPOR LAMPS (see Lamps)

METAL COATING AND PLATING
Andrews Lead Co., Inc.
Atlas Powder Co.
Bakelite Corp.
Baker & Co. Inc.
J. Bishop & Co. Platinum Works (Rhodium, Platinum, Paladium)
Electro Chemical Supply & Engrg. Co.
Lead Lined Iron Pipe Co.

METAL CONTAINERS
Aluminum Co. of America
Duriron Co. Inc., The (acid resisting)
Ingersoll Steel & Disc. Div., Borg-Warner Corp.
Pressed Steel Tank Co.
Republic Steel Corp.
Wheeling Corrugating Co., Steel Shipping Container Div.

METALS
Allegheny Steel Co.
Andrews Lead Co. Inc. (sheet lead, lead wool, caulking lead, lead wire, rod and bar)
Antaciron, Inc. (acid proof)
Baker & Co. Inc. (precious alloys, heat and corrosion resistant for glass manufacture)
J. Bishop & Co. Platinum Works (precious)
Duriron Co. Inc., The (alloy, Durimet, Durco, Alcumite)
Eimer & Amend
Fansteel Metallurgical Corp. (tantalum, columbium, tungsten, molybdenum)
Ingersoll Steel & Disc. Div., Borg-Warner Corp. (stainless and stainless clad)
International Nickel Co. Inc. (corrosion resistant alloys, nickel alloys, nickel, monel, Inconel, Ni-resist, Ni-hard, nickel cast iron, nickel steels)
Lead Lined Iron Pipe Co.
P. R. Mallory & Co. (bimetals for electrical contact, corrosion resistance and thermostatic use, special forms of tungsten and molybdenum)
National Lead Co. (antimonial sheet lead, chemical sheet lead, tellurium sheet lead, babbitt and casting metals, type metals, solder, pewter, etc.)
Republic Steel Corp.
Titanium Alloy Mfg. Co.
Worthington Pump & Mchy. Corp.

METERS
American Meter Co. (displacement measurement for gases and air, low and high pressure, indicating, recording or integrating orifice flowmeters for gases, air, steam, oil and other liquids)
Bailey Meter Co. (flow)
Brown Instrument Co. (flow for recording rate and totalizing quantity of fluid passing through a pipe)
Builders Iron Foundry (shunt, flo-watch, venturi)
Eimer & Amend
Foxboro Co. (flow)
Hoke, Inc. (flow, orifice and float type, gas, flow pressure).
Illinois Testing Laboratories, Inc. (air velocity)
Merco Nordstrom Valve Co. (water, gas, air, oil and other liquids)
National Technical Laboratories (viscosimeters, hydrogen ion)
Pfaltz & Bauer Inc.
Taylor Instrument Cos. (temperature, pressure, flow and level)
Westinghouse Elec. & Mfg. Co. (electric)
Worthington Pump & Mchy. Corp. (liquid)

MICROSCOPES
Bausch & Lomb Optical Co.
Eimer & Amend
E. Leitz, Inc.
N. J. Laboratory Supply Co.
Pfaltz & Bauer Inc.
Carl Zeiss, Inc.

MILLS
Abbe Engrg. Co. (jar, pebble and ball)
Paul O. Abbe, Inc. (ball, pebble, grinding and mixing)
Beach-Russ Co. (jar, pebble and ball)
J. H. Day Co., The
Denver Equipment Co. (ball, laboratory, portable, rod, truck, tube)
Eimer & Amend
Eppenbach, Inc. (colloid)
Goslin-Birmingham Mfg. Co. (cane)
Premier Mill Corp. (colloid)
Raymond Pulverizer Div., Combustion Engrg. Corp.
Robinson Mfg. Co. (attrition and hammer)
Sprout, Waldron & Co. (roller, attrition or plate, Burr)
Storms-Harvey Equip. Co. (3 roll, ink and paint)
Struthers-Wells (ball)
U. S. Stoneware Co. (jar)
Williams Patent Crusher & Pulverizer Co. (hammer, roller, dryer)

MINERALS
Eimer & Amend
Titanium Alloy Mfg. Co.

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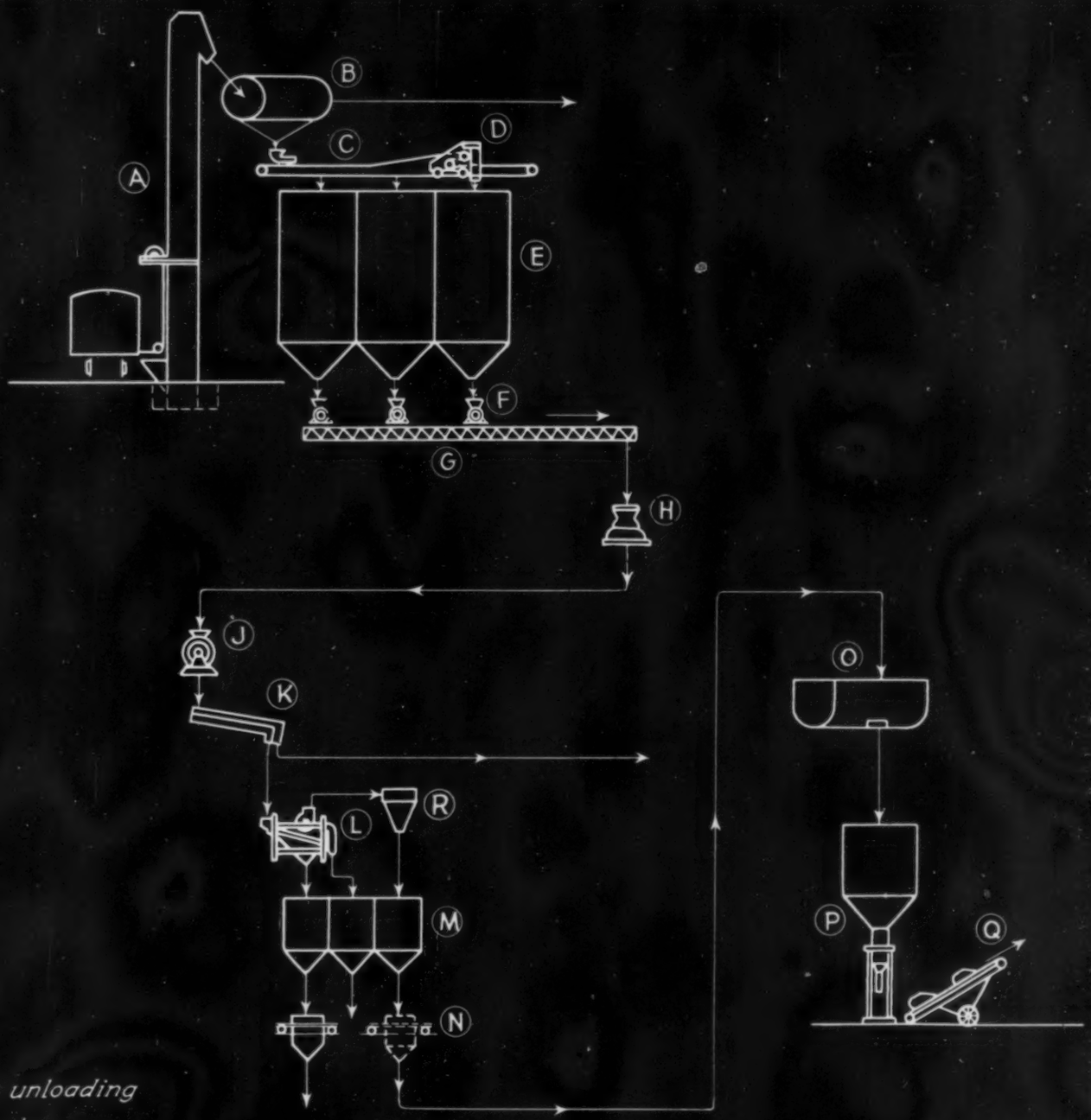

A *Bulk unloading*
B *Cleaning*
C *Bulk conveying (belt)*
D *Distributing*
E *Storage*
F *Volume control*
G *Conveying (screw)*
H *Crushing*
J *Pulverizing*
K *Classifying (by size)*
L *Classifying (by specific gravity)*
M *Storage*
N *Weighing*
O *Mixing (batch or continuous)*
P *Packaging*
Q *Car loading*
R *Dust collecting*

New at the show
Old in achievements

SPROUT WALDRON & CO
MUNCY PA

If your process involves any of the operations shown in flow sheet above, (and whose doesn't?) you will want to visit our exhibit on the third floor at the Chemical show

BOOTHS NO. 531-2-3 & 4

MIXERS
- Eppenbach, Inc. (portable, air-less)
- Haveg Corp. (chemical, drug)
- Mixing Equipment Co. Inc. (propeller type, portable)
- Robinson Mfg. Co. (Gardner, Unique, trowel type)

MIXING AND KNEADING MACHINERY
- Abbe Engrg. Co.
- Paul O. Abbe, Inc.
- Alsop Engrg. Corp.
- American Machine & Fdry. Co.
- American Seitz Filter Co.
- Beach-Russ Co.
- Baker Perkins Co. Inc.
- Blaw-Knox Co. (mixing)
- J. H. Day Co., The
- Gruendler Crusher & Pulverizer Co.
- B. F. Gump Co.
- New England Tank & Tower Co.
- Lancaster Iron Works, Inc.
- Pfaudler Co.
- Ransome Concrete Mchy. Co.
- Robinson Mfg. Co.
- Read Machinery Co.
- Sowers Mfg. Co.
- Sprout, Waldron & Co.
- Stephens, Adamson Mfg. Co.
- F. J. Stokes Machine Co.
- Struthers-Wells
- Turbo Mixer Corp.

MOLDING MACHINERY
- Haveg Corp.
- Hydraulic Press Mfg. Co. (plastic, injection & laboratory presses)

MONEL METAL (see Metals)

MOTORS—Electric
- Louis Allis Co., The
- C. O. Bartlett & Snow Co.
- Eimer & Amend
- Fairbanks, Morse & Co.
- General Electric Co.
- Reeves Pulley Co. of N. Y. Inc.
- Rowan Controller Co.
- Storms-Harvey Equip. Co. (2 speed and exp. proof)
- Westinghouse Elec. & Mfg. Co.

NAVAL STORES
- Hercules Powder Co.
- Industrial Chemical Sales Div., West Virginia Pulp & Paper Co.

NEON GLOW LAMPS (see Lamps)

NITRATORS
- Blaw-Knox Co.
- Duriron Co. Inc., The
- General Ceramics Co.
- Goslin-Birmingham Mfg. Co.
- Maurice A. Knight
- Pfaudler Co.

NODULATING EQUIPMENT
- Sprout, Waldron & Co.

NOZZLES—Spray
- Duriron Co. Inc., The (mixing, acid resisting)
- General Alloys Co.
- Haveg Corp.
- Kinney Mfg. Co.
- Link-Belt Co.
- Monarch Mfg. Works, Inc.
- U. S. Stoneware Co.
- Worthington Pump & Mchy. Corp.

OIL CRACKING EQUIPMENT
- Blaw-Knox Co.

OVENS—Electric, Laboratory
- Eimer & Amend
- Fish-Schurman Corp.
- N. J. Laboratory Supply Co.
- Palo-Myers, Inc.
- Pfaltz & Bauer Inc.
- Philadelphia Drying Mchy. Co.
- Precision Scientific Co.
- Scientific Glass Apparatus Co.

OVENS—Industrial
- American Machine & Fdry. Co.
- Korb-Pettit Wire Fabrics & Iron Works
- Philadelphia Drying Mchy. Co.

PACKAGING EQUIPMENT
- Acme Steel Co. (bale ties, barbed straps, stitching wire, strapping tools and equipment, wood joint fasteners)
- American Machine & Fdry. Co.
- Bemis Bro. Bag Co.
- B. F. Gump Co.
- Karl Kiefer Machine Co.
- Paper Service Co. (vapor and waterproof linings)
- Pneumatic Scale Corp. Ltd. (wrapping and lining machines)
- Reeves Pulley Co. of N. Y. Inc.
- St. Regis Paper Co.
- Sprout, Waldron & Co.
- F. J. Stokes Machine Co.
- Stokes & Smith Co.
- Syntron Co.

PACKERS
- B. F. Gump Co. (barrel and bag, vibrating for barrel and bag, and small containers)

PACKING
- Crane Packing Co. (all kinds, metallic, plastic, fabric)
- Custodis Construction Co. Inc. (ACO Triple Spiral ring tower)
- Durametallic Corp. (flexible type and plastic type, Dura Seal, mechanical)
- Garlock Packing Co. (seals, oil and grease, rubber, asbestos, Neoprene, Thiokol, Semi-metallic, leather)

PAINT SPRAYING EQUIPMENT
- C. O. Bartlett & Snow Co.
- Mine Safety Appliances Co.

PAINTS
- Custodis Construction Co. Inc. (Kabe Acid-Resisting)

PAPER MACHINERY
- Bird Machine Co.
- Dorr Co., Inc., The
- Goslin-Birmingham Mfg. Co.
- Gruendler Crusher & Pulverizer Co.
- Hills-McCanna Co. (valves)
- Productive Equipment Corp.
- Reeves Pulley Co. of N. Y. Inc.
- Sprout, Waldron & Co.
- Taylor Instrument Cos.
- Tolhurst Centrifugal Div., American Machine & Metals
- Williams Patent Crusher & Pulverizer Co. (shredders)

PARCHMENT
- H. Reeve Angel & Co. (dialyzing)

PERFORATED METALS
- Allegheny Steel Co.
- Baker & Co., Inc.
- J. Bishop & Co. Platinum Works (platinum)
- Williams Patent Crusher & Pulverizer Co.

PHARMACEUTICAL MACHINERY
- Alsop Engrg. Corp.
- American Seitz Filter Co.
- C. O. Bartlett & Snow Co.
- Chemicolloid Laboratories, Inc.
- Ertel Engrg. Corp.
- Karl Kiefer Machine Co.
- Pfaudler Co.
- Read Machinery Co.
- Robinson Mfg. Co.
- T. Shriver & Co.
- F. J. Stokes Machine Co.
- Stokes & Smith Co.

PHARMACEUTICALS
- Chas. Pfizer & Co. (acids, tartar preparations, citrates, gluconates, iodides, bismuth salts, mercurials, oxalates)

PHOTOMETERS
- Carl Zeiss, Inc.

PHOTO-MICROGRAPHIC EQUIPMENT
- Carl Zeiss, Inc.

PIGMENTS
- Titanium Alloy Mfg. Co.
- Wishnick-Tumpeer, Inc.

PIPE AND FITTINGS
- Allegheny Steel Co. (stainless)
- American Hard Rubber Co.
- Andrews Lead Co. Inc.
- Antaciron, Inc. (acid proof, split flanged, and bell & spigot)
- Crane Co.
- Corning Glass Works (glass)
- Duriron Co. Inc., The (acid resisting, flanged, bell & spigot)
- Fish-Schurman Corp. (line filters for pipe lines)
- General Alloys Co. (acid resisting alloy)
- General Ceramics Co.
- Haveg Corp.
- Kewaunee Mfg. Co. ("Karcite")
- Maurice A. Knight (acid proof)
- Lead Lined Iron Pipe Co. ("Wakefield Amalgamated," galvanized and acid resisting, lead lined and pure block tin lined)
- National Lead Co. (lead lined, tin lined, antimonial lead, chemical lead, tellurium lead)
- Parker Appliance Co. (brass and steel)
- Pfaudler Co. (glass lined)
- Republic Steel Corp. (Toncan, Republic)
- Struthers-Wells (jacketed)
- U. S. Stoneware Co. (acid proof)

PIPE—SILICA WARE
- Amersil Co. Inc.
- Eimer & Amend
- Fish-Schurman Corp.

PIPE SAVERS
- Sarco Company, Inc.

PLASTIC EQUIPMENT
- Sprout, Waldron & Co.
- F. J. Stokes Machine Co. (molding)

PLASTICS
- Bakelite Corp.
- Haveg Corp.
- Neville Co.
- The Resinox Corporation
- Stokes & Smith Co.
- Tennessee Eastman Corp. (molding composition)

PLATINUM—Wire, Sheet, Foil, Crucibles, Laboratory Ware
- Baker & Co., Inc.
- J. Bishop & Co. Platinum Works (alloys)
- Eimer & Amend
- Scientific Glass Apparatus Co.

PORCELAIN WARE
- Paul O. Abbe, Inc.
- Eimer & Amend
- Ertel Engrg. Corp.
- Fish-Schurman Corp.
- General Ceramics Co.
- N. J. Laboratory Supply Co.
- Scientific Glass Apparatus Co.

POWER—Electric
- Fairbanks, Morse & Co.
- Westinghouse Elec. & Mfg. Co.

POWER TRANSMISSION
- Westinghouse Elec. & Mfg. Co. (gear units & gear motors)
- Worthington Pump & Mchy. Corp. (V-Belt drives)

PRECIPITATORS
- Pangborn Corp. (electrostatic)

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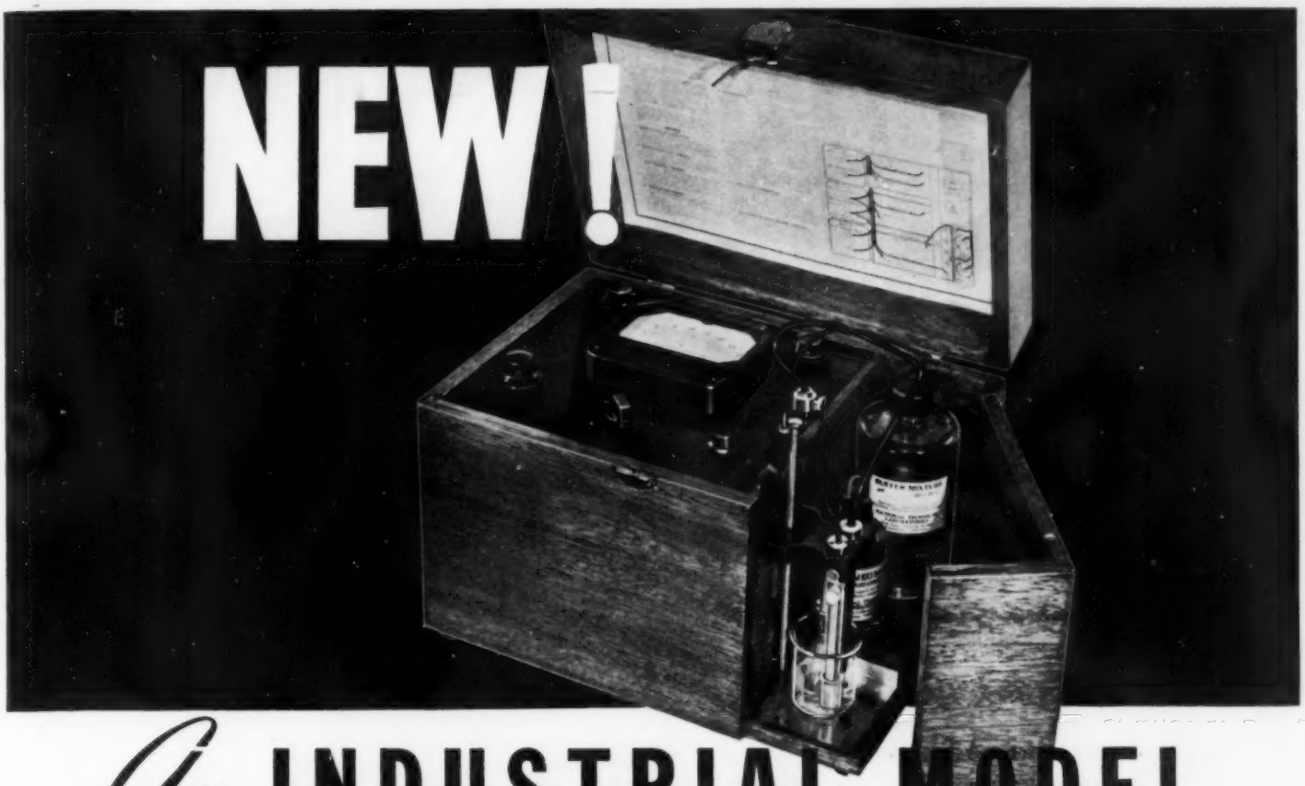
BOOTH 515



An INDUSTRIAL MODEL

OF THE BECKMAN pH METER *WITH THESE EXCLUSIVE FEATURES:*

AUTOMATIC pH INDICATION . . . . the meter needle automatically swings to the exact pH reading at the touch of a button!

CONTINUOUS pH INDICATION . . . . for process control, titration, etc., by merely locking the push button! Operator's hands are then entirely freed.

INTERNALLY SHIELDED GLASS ELECTRODE . . . . gives complete freedom from electrostatic disturbances. May be used in vats or tanks for continuous process control.

. . . . and many other performance features combining laboratory accuracy with fool-proof simplicity and rugged construction.

See the Industrial and the Laboratory Models of the Beckman pH Meter in Booth 515, Chemical Exposition, New York City (Dec. 6-10). Bring samples for free testing, and learn how these instruments can increase the quality and decrease the cost of your products!

WRITE FOR ILLUSTRATED BULLETIN C-12 DESCRIBING THE INDUSTRIAL MODEL!

NATIONAL TECHNICAL *Laboratories*

3330 EAST COLORADO STREET, PASADENA, CALIFORNIA

PRESSES
Fred S. Carver (hydraulic filter, cocoa, laboratory)
Denver Equipment Co. (filter)

PRESSES—Hydraulic
Fred S. Carver (filter)
Hydraulic Press Mfg. Co.
T. Shriver & Co.

PRESSURE VESSELS
Black, Sivalls & Bryson, Inc.

PUBLICATIONS
American Meter Co. (Handbook of gas measurement by displacement meters. Handbook of orifice measurement)
Chemical Industries
Chemical & Metallurgical Engrg.
Food Industries
McGraw-Hill Publ. Co.
Metal Industry Publishing Co.
Reinhold Publishing Corp.

PULVERIZERS
Abbé Engrg. Co.
Paul O. Abbe, Inc.
C. O. Bartlett & Snow Co.
Beach-Russ Co.
J. H. Day Co., The
Eimer & Amend
Gruendler Crusher & Pulverizer Co.
Hardinge Co. Inc.
Hurricane Pulverizer Co.
Jeffrey Mfg. Co.
Pulverizing Machinery Co.
Raymond Pulverizer Div., Combustion Engrg. Corp.
Robinson Mfg. Co.
Stephens-Adamson Mfg. Co.
Sprout, Waldron & Co.
Williams Patent Crusher & Pulverizer Co.

PUMPS
Abbé Engrg. Co. (vacuum, rotary, liquid, centrifugal)
Alsop Engineering Corp.
American Hard Rubber Co.
Antaciron, Inc. (centrifugal, acid proof)
Beach-Russ Co. (vacuum, rotary, liquid, centrifugal)
Buffalo Foundry & Machine Co. (dry vacuum)
Builders Iron Foundry
Corning Glass Works (glass)
Denver Equipment Co. (centrifugal, diaphragm)
Duriron Co. Inc., The (acid resisting, centrifugal, self-priming and reciprocating)
Eimer & Amend
Eppenbach, Inc. (positive displacement)
Ertel Engrg. Corp.
Fairbanks, Morse & Co.
Foster Pump Works, Inc. (rotary, vacuum, positive pressure, blower, steam, centrifugal)
General Ceramics Co.
Hills-McCanna Co. (chemical proportioning)
Hydraulic Press Mfg. Co. (hydraulic power)
Karl Kiefer Machine Co. (rotary)
Kinney Mfg. Co. (dry vacuum, general service, viscous materials, loaded coating)
LaBour Co., Inc. (chemical, self priming, centrifugal, construction)
Lead Lined Iron Pipe Co. ("Wakefield" all lead or lead lined centrifugal)
Nash Engineering Co. (vacuum, vacuum heating, return line, condensation, suction sump, suction sewage, centrifugal, standard and self priming)
National Lead Co. (hard lead acid, tin lined)
Oliver United Filters Inc. (acid handling, vacuum, turbine)
Proportioneers, Inc. (Tret-O-Units for chemical treating, blending, proportioning, automatic dilution, etc.)
Quimby Pump Co. (centrifugal, rotary)
T. Shriver & Co. (diaphragm)
Claude B. Schneible Co.
F. J. Stokes Machine Co. (high vacuum)
U. S. Stoneware Co. (acid)
Worthington Pump & Mchy. Corp. (all kinds)

PURIFIERS
Sharples Specialty Co. (centrifugal)

PYROMETERS
Amersil Co. Inc. (quartz glass)
Bailey Meter Co.
J. Bishop & Co. Platinum Works (thermocouples for platinum and rodium)
Bristol Co.
Brown Instrument Co.
Eimer & Amend
Foxboro Co.
Fish-Schurman Corp.
Illinois Testing Laboratories, Inc.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos.

QUARTZ
Hanovia Chemical & Mfg. Co. (fused)

RAW MATERIAL
Bakelite Corp.
Glyco Products Co. Inc.
Philadelphia Quartz Co.
Sharples Solvents Corp.
Tennessee Eastman Corp. (cellulose acetate)
U. S. Industrial Alcohol Co.
U. S. Industrial Chemical Co.

RAYON EQUIPMENT
American Hard Rubber Co.
Andrews Lead Co. Inc.
Baker & Co., Inc.
Baker Perkins Co. Inc.
J. Bishop & Co. Platinum Works (spinnerettes)
Duriron Co. Inc., The (acid resisting)
Fansteel Metallurgical Corp.
General Ceramics Co.
Hydraulic Press Mfg. Co.
Henry E. Jacoby
Lead Lined Iron Pipe Co.
Philadelphia Drying Mchy. Co.
Read Machinery Co.
Robinson Mfg. Co.
Sharples Specialty Co.
Sprout, Waldron & Co.
Swenson Evaporator Co.
Taylor Instrument Cos.
Turbo Mixer Corp.

RECORDING INSTRUMENTS
American Meter Co. (see meters)
Bailey Meter Co.
Bristol Co.
Brown Instrument Co.
Eimer & Amend
Foxboro Co.
Mine Safety Appliances Co. (gas analysis)
Pfaltz & Bauer Inc.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos. (type of load)
Westinghouse Elec. & Mfg. Co.

RECTIFIERS
Westinghouse Elec. & Mfg. Co. (mercury arc, plate type)

REDUCERS
Foote Bros. Gear & Mach. Co. (motorized, speed)

REFRACTORIES
Carborundum Co.
Eimer & Amend
Electro Chemical Supply & Engrg. Co.
Fish-Schurman Corp.
Norton Co.
Quigley Co. (Insulbrix Cast-Refract, Insulblox, Catable, Hearth-Crete, Insulag, Insulcrete)
Titanium Alloy Mfg. Co.

REFRACTOMETERS
Carl Zeiss, Inc.

REFRIGERATION EQUIPMENT
Worthington Pump & Mchy. Corp.

REGULATORS—Pressure and Temperature
American Meter Co. (gas or air pressure control)
Bailey Meter Co.
Crane Co.
Eastern Engrg. Co.
Eimer & Amend.
Foxboro Co. (pressure and temperature)
Hoke, Inc. (gas pressure)
Hydraulic Press Mfg. Co. (pressure)
Matheson Co.
Merco Nordstrom Valve Co. (gas and air pressure)
Monarch Mfg. Works, Inc. (pressure)
Sarco Company, Inc.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos.

RESINS AND OILS
Bakelite Corp.
Eimer & Amend
Glyco Products Co. Inc. (synthetic, water soluble)
Hercules Powder Co. (synthetic)
Neville Co.
Pfaltz & Bauer Inc.
The Resinox Corp. (moulding)
Wishnick-Tumpeer, Inc.

RESPIRATORS
Eimer & Amend
Hoke, Inc. (Branower for artificial resuscitation)
Mine Safety Appliances Co.
Pangborn Corp.

ROTARY FEEDERS (see Feeders)

RUBBER PRODUCTS AND EQUIPMENT
Paul O. Abbe, Inc.
American Hard Rubber Co.
Garlock Packing Co.
Maurice A. Knight
Robinson Mfg. Co.

RUBBER RECLAIMING EQUIPMENT
Sprout, Waldron & Co.

RUST PROOFING
Electro Chemical Supply & Engrg. Co.
Neville Co.
Philadelphia Quartz Co.

SAFETY EQUIPMENT
Acme Steel Co. (matting)
Antaciron, Inc.
Bausch & Lomb Optical Co.
Black, Sivalls & Bryson, Inc.
Brown Instrument Co. (combustion safeguard)
Fish-Schurman Corp.
General Electric Vapor Lamp Co.
Hills-McCanna Co. (tools)
Walter Kidde & Co.
Korb-Pettit Wire Fabrics & Iron Works (guards for windows, grilles)
Mine Safety Appliances Co. (gas masks, dust masks)
Pangborn Corp.
Westinghouse Elec. & Mfg. Co. (electric)

SCALES
Christian Becker, Inc.
Builders Iron Foundry (automatic conveyor, Chronoflo)
Eimer & Amend
Fairbanks, Morse & Co.
Exact Weight Scale Co.
B. F. Gump Co. (net and gross automatic)
Newark Scale Works
N. J. Laboratory Supply Co.
Pfaltz & Bauer Inc.
Pneumatic Scale Corp. Ltd. (weighing machines)

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"Fluid-ize" YOUR FLOW OF SOLIDS

SEE THEM AT THE SHOW

Once you have watched these all-electric vibrating units on process work, your own mind will begin to turn out logical "I've-got-it" solutions of knotty handling problems in your own plant. You'll begin to visualize the possibilities immediately . . . on ordinary jobs, where seemingly irreducible costs actually can be lowered . . . on precision jobs, where close control is required . . . on dangerous or delicate jobs, where gentle handling is demanded . . . on dusty or gassy jobs, where total closure is the only safe solution . . . in handling quality products, where the demand for purity and appearance forbids degradation, discoloration, contamination or dulling of crystal luster.

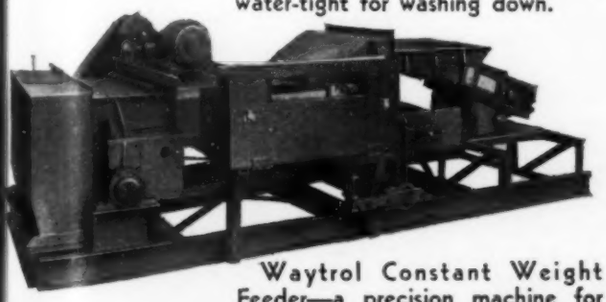
Conveyed solids are buoyed up and travel in fluid-like flow over smooth surfaces . . . channels can be furnished in stainless steel or glass if desired. There are no mechanical working parts . . . no lubrication is required. Cushioning avoids noise and transmission of vibration to structure. Discharge rate can be instantly and accurately adjusted between wide limits.

See these units working at the Chemical Show . . . or in one of many processing plants which we'll gladly name for you — Jeffrey-Traylor Division, The Jeffrey Manufacturing Co., Columbus, Ohio.

All-electric Vibrating Conveyor—for handling hot gaseous abrasive sinters, calcines, roasts, chemicals, food stuffs, sand, cullet, glass batch, etc. Furnished in pan type also.

All-electric Vibrating Conveyan-screen—for scalping and screening. Operates in closed circuit with grinding mills, may be totally enclosed.

All-electric Low Head Barrel Packer — decreases packing time 50%, increases density 30% over mechanical units. Can be installed water-tight for washing down.



Waytrol Constant Weight Feeder—a precision machine for weighing, feeding, batching and proportioning. Delivers by weight not by volume.

JEFFREY
ELECTRIC VIBRATING EQUIPMENT
COLUMBUS, OHIO

Feeding	Conveying	Screening	Weighing
Spreading	Packing	Cooling	Proportioning
Inspecting	Packaging	Drying	Batching

St. Regis Paper Co.
Seederer-Kohlbusch, Inc.
Stokes & Smith Co.
Storms-Harvey Equip. Co.
Syntron Co.
Toledo Scale Co.

SCREENS—Inclined, Vibratory, Gyratory
J. H. Day Co., The
Denver Equipment Co.
Gruendler Crusher & Pulverizer Co.
B. F. Gump Co.
Jeffrey Mfg. Co.
Korb-Pettit Wire Fabrics & Iron Works
Link-Belt Co.
Productive Equipment Corp.
Robinson Mfg. Co.
John A. Roebling's Sons Co.
Sprout, Waldron & Co.
Stephens, Adamson Mfg. Co.
Syntron Co.
W. S. Tyler Co.
Williams Patent Crusher & Pulverizer Co.

SCREENS—Other
Abbé Engrg. Co.
C. O. Bartlett & Show Co. (revolving)
Beach-Russ Co.
Cuno Engineering Corp. (self cleaning)
J. H. Day Co., The
Denver Equipment Co. (laboratory, revolving)
Eimer & Amend (sieves)
Fansteel Metallurgical Corp.
Gruendler Crusher & Pulverizer Co.
Korb-Pettit Wire Fabrics & Iron Works
Newark Wire Cloth Co.
Robinson Mfg. Co. (gyro sifter, swing sifter)
John A. Roebling's Sons Co.
Stephens, Adamson Mfg. Co. (revolving)
W. S. Tyler Co.

SEALING MACHINES
B. F. Gump Co.
Pneumatic Scale Corp. Ltd. (capping machines)
F. J. Stokes Machine Co. (tube)
Stokes & Smith Co.

SEPARATORS
Dings Magnetic Separator Co. (magnetic)
Federal Pneumatic Systems, Inc. (air)
Hardinge Co. Inc. (air)
National Lead Co. (for sludge acid)
Pangborn Corp. (abrasive, moisture and oil)
Raymond Pulverizer Div., Combustion Engrg. Corp. (air)
Robinson Mfg. Co. (grain)
Rochester Engrg. & Centrifugal Corp. (centrifugal)
Separations Engrg. Corp. (air, electrostatic)
Sharples Specialty Co. (centrifugal)
Sprout, Waldron & Co.
Struthers-Wells (entrainment)
Sutton, Steele & Steele, Inc. (electrostatic)
Tolhurst Centrifugal Div., American Machine & Metals
Williams Patent Crusher & Pulverizer Co. (air & mechanical)

SHEET METAL WORK
Allegheny Steel Co.
Andrews Lead Co.
J. Bishop & Co. Platinum Works (platinum, sheet & foil)
Ingersoll Steel & Disc Div., Borg-Warner Corp.
Henry E. Jacoby
Korb-Pettit Wire Fabrics & Iron Works
Robinson Mfg. Co.
Sprout, Waldron & Co.

SIEVES—Laboratory
Eimer & Amend
Korb-Pettit Wire Fabrics & Iron Works
Newark Wire Cloth Co.
Precision Scientific Co.
John A. Roebling's Sons Co.
Scientific Glass Apparatus Co.
Sprout, Waldron & Co.
W. S. Tyler Co.

SIFTERS
Abbé Engrg. Co.
American Machine & Fdry. Co.
Beach-Russ Co.
J. H. Day Co., The
Eimer & Amend
B. F. Gump Co.
Korb-Pettit Wire Fabrics & Iron Works
Newark Wire Cloth Co.
Read Machinery Co.
Robinson Mfg. Co.
John A. Roebling's Sons Co.
Sprout, Waldron & Co.
F. J. Stokes Machine Co.
Storms-Harvey Equipment Co
W. S. Tyler Co.
Williams Patent Crusher & Pulverizer Co.

SINKS—Laboratory, Acid proof
Alberene Stone Corp. of Va.
Allegheny Steel Co.
American Hard Rubber Co.
Andrews Lead Co. Inc.
Antaciron, Inc.
Duriron Co. Inc., The
Eimer & Amend
General Ceramics Co.
Ingersoll Steel & Disc Div., Borg-Warner Corp.
Maurice A. Knight
Laboratory Furniture Co.
Leonard Peterson & Co.
E. H. Sheldon & Co.
U. S. Stoneware Co.

SOFTENING & CONDITIONING AGENTS
Atlas Powder Co.

SOLVENT RECOVERY EQUIPMENT
Barnstead Still and Sterilizer Co. Inc.
Blaw-Knox Co.
Buffalo Foundry & Machine Co.
Builders Iron Foundry
J. P. Devine Mfg. Co. Inc.
Goslin-Birmingham Mfg. Co.
Ingersoll Steel & Disc Div., Borg-Warner Corp.
Henry E. Jacoby
Pfaudler Co.
Precision Scientific Co.
Claude B. Schneible Co.
F. J. Stokes Machine Co.
Struthers-Wells

SOLVENTS
Commercial Solvents Corp.
Eimer & Amend
Electro Bleaching Gas Co.
Glyco Products Co. Inc.
Hercules Powder Co.
Neville Co.
Niagara Alkali Co.
Sharples Solvents Corp.
U. S. Industrial Alcohol Co.
U. S. Industrial Chemical Co.

SPECIFIC GRAVITY APPARATUS
American Meter Co. (for gases, sampling and recording)

SPEED REDUCERS
Denver Equipment Co.
Foote Bros. Gear & Mach. Corp.
Link-Belt Co.

SPRAY DRYING SYSTEMS
Bowen Research Corp.
Korb-Pettit Wire Fabrics & Iron Works

SPRAYING EQUIPMENT
Quigley Co. (refractory gun, shoots refractory and concrete mixtures)

STAINLESS STEEL (see metals)

STAIR STEPS—Safety
Blaw-Knox Co.
Korb-Pettit Wire Fabrics & Iron Works

STEEL GRATING AND FLOORING
Acme Steel Co.
Allegheny Steel Co.
Blaw-Knox Co.
Korb-Pettit Wire Fabrics & Iron Works

STERILIZERS
American Seitz Filter Co.
Barnstead Still & Sterilizer Co. Inc.
Buffalo Foundry & Machine Co.
Eimer & Amend
Pfaltz & Bauer Inc.
Rochester Engrg. & Centrifugal Corp.
Struthers-Wells

STILLS
Amersil Co. Inc. (water and mercury)
Andrews Lead Co. Inc. (lead)
Barnstead Still & Sterilizer Co. Inc. (water and solvent)
Buffalo Foundry & Machine Co.
General Ceramics Co.
Haveg Corp.
Ingersoll Steel & Disc Div., Borg-Warner Corp.
Henry E. Jacoby (water, alcohol, etc.)
National Lead Co. (pressure, vacuum for purifying acid)
Palo-Meyers Inc. (water)
Pfaudler Co. (glass lined)
Precision Scientific Co. (water, oil [petroleum] tar, solvent recovery)
Claude B. Schneible Co.
Sowers Mfg. Co. (batch type)
F. J. Stokes Machine Co. (water, vacuum)
Struthers-Wells (continuous, batch)
U. S. Stoneware Co. (acid)

STRAINERS
American Seitz Filter Co.
Crane Co.
Foster Pump Works, Inc. (pipe line, sanitary, pit)
General Ceramics Co.
Kinney Mfg. Co. (plain and steam jacketed)
Korb-Pettit Wire Fabrics & Iron Works
Monarch Mfg. Works, Inc.
Newark Wire Cloth Co.
John A. Roebling's Sons Co.
Sarco Company, Inc.

STRAPPING—Steel
Acme Steel Co.

SULPHONATORS
Blaw-Knox Co.

SWITCHES
General Electric Vapor Lamp Co. (Kon-nec-tors Mercury)
Rowan Controller Co.
Westinghouse Elec. & Mfg. Co. (electric)

TACHOMETERS
Bristol Co.
Brown Instrument Co.
Foxboro Co.
Reeves Pulley Co. of N. Y. Inc.
Westinghouse Elec. & Mfg. Co.

TANK LININGS (see Linings)

TANKS
Alsop Engrg. Co.
American Hard Rubber Co.
Andrews Lead Co. Inc. (lead lined)
Blaw-Knox Co. (pressure)
Black, Sivalls & Bryson, Inc.
Duriron Co. Inc., The (acid resisting)
Electro Chemical Supply & Engrg. Co. (acid proof)

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BOOTH 89

You can rely on "U. S. Stoneware" for all corrosion-proof jobs

RASCHIG RINGS • All sizes from 3/8" O.D. up to 6" O.D.,—in both white porcelain or chemical stoneware — uniformally shaped, stronger, tougher, non-porous and non-absorbent. None but the purest, de-aired and electrolyzed clays are used in the making of these rings. They will not chip, spall or crumble.

• Send for Bulletin #74-A

ACID-PROOF CEMENTS • "U. S. Stoneware" acid-proof cements are acid-proof in more than name. They are quick-setting and self-hardening *all the way through*. These cements will resist all acids, hot or cold (with the single exception of hydrofluoric), and make acid-proof construction ready for use within two or three days. • Send for Bulletin #801

ACID TANKS, VATS, ETC. • We offer a full line of chemical stoneware Tanks, Jars, Pots, Vats, Kettles, etc., in all sizes, shapes and designs. Prompt shipments can be made on standard vessels, with or without outlets, valves or covers. Special sizes or shapes can be made to order.

• Send for Bulletin #404

SUCTION FILTERS • A full line of air-and-vacuum tight suction and gravity filters guaranteed acid, alkali and corrosion-proof. Stocked in five standard types, from small laboratory sizes to large, heavy duty industrial units, able to withstand a complete vacuum. • Send for Bulletin #410

"FLEXLOCK" PIPE JOINTS • For use with U. S. Stoneware "Flexlock" Specification Bell-and-Spigot Piping. These joints assure positive seal, flexibility, permanence and low initial installed cost. They are unaffected by any fluid (hydrofluoric acid excepted). Sizes from 1½" to 36" inside diameter.

• Send for Bulletin #902

SPIRAL PACKING RINGS • Our "Cyclohelix" and "Hexahelix" Spiral Packing Rings are the outstanding spiral packing rings on the market. Made of de-aired and electrolyzed clays, in 3¼", 4" and 6" sizes, in the single-spiral, double-spiral and triple-spiral types. • Send for Bulletin #74

ACID-PROOF BRICK AND LINING TILE • In all shapes, sizes and radii, made of de-aired and electrolyzed clays. Each brick is subjected to a pressure of several tons thus insuring a uniformally tight body texture and straight edges and facilitating construction. Ideal for acid storage tanks, towers, acid-proof floors, etc.

• Send for Bulletin #802

"FLEXLOCK" SPLIT SLEEVES • "Flexlock" Split Sleeves are recommended (1) for repairs on pipe lines, (2), for pipe lines that must be completely or partially taken down at intervals, and (3), for connection to pumps, tanks, towers, etc. They perform the same functions as unions in screwed joint lines. Available in all sizes. • Send for Bulletin #904

ACID AND CHEMICAL-PROOF LABORATORY SINKS, ETC. • Acid-proof, chemical-proof and corrosion-proof throughout the entire stoneware body. All sizes and styles, with or without integral drainboards. *One-piece* construction with rounded corners, non-porous and non-absorbent. Every sink unconditionally guaranteed to give full satisfaction.

• Send for Bulletin #503

Be Sure To See Our Exhibit — Booth 89 at The CHEMICAL EXPOSITION

THE U. S. STONEWARE CO., AKRON, OHIO

Ertel Engrg. Corp. (stainless steel and glass lined),
General Ceramics Co.
Haveg Corp. (of all kinds)
Ingersoll Steel & Disc Div., Borg-Warner Corp.
Henry E. Jacoby (non-ferrous plate, plain, jacketed, open top, pressure, vacuum)
Maurice A. Knight (acid proof)
Lead Lined Iron Pipe Co. ("Wakefield Amalgamated" lead or tin lined)
Metal Glass Products Co. (glass lined, stainless steel)
National Lead Co. (homogeneous lead lined)
New England Tank & Tower Co. (wood)
Pfaudler Co. (glass lined, distilled water storage)
Pressed Steel Tank Co. (pressure)
Robinson Mfg. Co. (all kinds)
Sprout, Waldron & Co.
Storms-Harvey Equip. Co. (mixing)
U. S. Stoneware Co. (acid)

TESTING EQUIPMENT
Atlas Electric Devices Co. (accelerated, weathering, fading, laundering)
Titanium Alloy Mfg. Co. (Opacifiers, Zirconium for vitreous enamels and glazes)

THERMOMETERS
Bristol Co.
Eimer & Amend
Foxboro Co.
Illinois Testing Laboratories, Inc.
N. J. Laboratory Supply Co.
Palo-Myers, Inc.
Scientific Glass Apparatus Co.
C. J. Tagliabue Mfg. Co.
Taylor Instrument Cos. (easy to read, Binoc, Industrial)

THICKENING AND DEWATERING MACHINERY
Baker Perkins Co. Inc.
Bird Machine Co.
Denver Equipment Co. (continuous, pulp, slime, tray)
Dorr Co. Inc., The
Goslin-Birmingham Mfg. Co.
Hardinge Co. Inc.
Korb-Pettit Wire Fabrics & Iron Works
Link-Belt Co.
Productive Equipment Corp.
Rochester Engrg. & Centrifugal Corp.
Claude B. Schneible Co.
Sharples Specialty Co.
Tolhurst Centrifugal Div., American Machine & Metals

TOOLS
Durametallic Corp. (hooks for removing packing)

TORCHES
Hoke, Inc. (glass blowing for working pyrex and quartz, oxygen-gas, for soldering, welding and melting metals including platinum)

TOWER PACKING OR FILLING
Custodis Construction Co. Inc. (ACO Triple Spiral rings)
Electro Chemical Supply & Engrg. Co.
General Ceramics Co.
Maurice A. Knight
Claude B. Schneible Co.
U. S. Stoneware Co.

TOWERS
Aluminum Co. of America
American Hard Rubber Co.
Amersil Co. Inc.
Antaciron, Inc. (acid)
Custodis Construction Co. Inc. (acid proof, masonry)
Duriron Co. (acid resisting, nitric concentrating, bleaching, de-nitrating)
Electro Chemical Supply & Engrg. Co.
General Ceramics Co.
Haveg Corp.
Maurice A. Knight
Struthers-Wells (fractionating)
U. S. Stoneware Co.

TRANSMISSION EQUIPMENT
Hydraulic Press Mfg. Co. (hydraulic)
Link-Belt Co. (chain drives, clutches, hangers, bearings, etc.)
Reeves Pulley Co. of N. Y. Inc.
Robinson Mfg. Co.
Sprout, Waldron & Co.
Stephens, Adamson Mfg. Co. (variable speed)
Storms-Harvey Equip. Co.
Westinghouse Elec. & Mfg. Co.

TRAPS
Haveg Corp.
Sarco Company, Inc. (steam, radiator)

TUBES
Allegheny Steel Co. (stainless)
American Hard Rubber Co.
Amersil Co. (silica and quartz)
Andrews Lead Co. Inc. (lead)
Antaciron, Inc. (acid concentrator)
Bailey Meter Co. (venturi)
Baker & Co. Inc.
J. Bishop & Co. Platinum Works (18-8 stainless steel, inconel nickel, monel metal in hypodermic, capillary and mechanical sizes, .012" O.D. to 1" O.D.)
Carborundum Co. (electric furnace)
Carpenter Container Co. (fibre)
Duriron Co. Inc., The (acid resisting)
Eimer & Amend
Fish-Schurman Corp. (porcelain, glass, KPG Precision Bore glass)
Kimble Glass Co. (glass)
Lead Lined Iron Pipe Co. ("Wakefield Amalgamated," Homogeneous lead covered & lead lined copper, steel or nickel)
Parker Appliance Co. (brass, aluminum, steel, etc.)
Republic Steel Corp. (stainless steel, boiler electrunite)

TURBINES
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mchy. Corp.

ULTRA VIOLET LAMPS
Atlas Electric Devices Co.
Eimer & Amend
Fish-Schurman Corp.
General Electric Vapor Lamp Co.
Hanovia Chemical & Mfg. Co.
Pfaltz & Bauer Inc.
Westinghouse Elec. & Mfg. Co. (electric)

VACUUM APPARATUS
National Lead Co. (homogeneous lead lined)

VALVES AND FITTINGS
Allegheny Steel Co.
Aluminum Co. of America
American Hard Rubber Co.
Andrews Lead Co. Inc. (lead)
Antaciron, Inc.
Crane Co. (chrome nickel alloy, monel, nickel, aluminum, Everdur, acid bronze, cast and malleable iron, steel, brass)
J. P. Devine Mfg. Co. Inc. (jacketed)
Duriron Co., Inc., The (acid resisting, angle, check, foot, gate, plug, safety and Y)
Fansteel Metallurgical Corp.
Foxboro Co.
General Ceramics Co.
Haveg Corp. (acid resisting, corrosion resisting, non-metallic)
Hills McCanna Co.
Hoke, Inc. (needle valves, blunt and V point, all types made of brass, chemically resistant alloys, gas pressure reducing including models for ammonia and hydrogen sulfide, reducing)
Hydraulic Press Mfg. Co.
Maurice A. Knight
Laboratory Furniture Co.
Lead Lined Iron Pipe Co. ("Wakefield Amalgamated," lead lined and pure block tin lined, Jenkins type screwed gate, acid resisting lead lined flanged, cast iron and steel valves, F. & D. gate, globe, angle and Y type, hard lead and Chemtrade, flanged Y type, acid valves F. & D.)
Matheson Co.
Merco Nordstrom Valve Co. (lubricated plug)
National Lead Co. (lead lined, hard lead, tin lined)
Parker Appliance Co.
Pfaudler Co.
Wm. Powell Co.
Sarco Company, Inc. (radiator)
Storms-Harvey Equipment Co. (oil gate)
Taylor Instrument Cos.
U. S. Stoneware Co.
Worthington Pump & Mchy. Corp.

VARNISHES
Dicalite Co. (flattening agents)
The Resinox Corp. (Laminating)

VENTILATING APPARATUS
American Hard Rubber Co.
General Ceramics Co.
Haveg Corp.
Mine Safety Appliances Co.
Pangborn Corp.
Claude B. Schneible Co.

VULCANIZERS
Struthers-Wells

WASHFOUNTAINS
Bradley Washfountain Co.

WASHROOM EQUIPMENT
Bradley Washfountain Co.

WATERPROOFING COMPOUNDS
Bakelite Corp.
Electro Chemical Supply & Engrg. Co.
Glyco Products Co. Inc. (for textiles)
Neville Co.

WATER SOFTENING EQUIPMENT
American Hard Rubber Co.
Builders Iron Foundry
Dorr Company, Inc., The

WAXES
Glyco Products Co. Inc. (cosmetic, synthetic, wax compounds)

WEATHEROMETER
Atlas Electric Devices Co. (accelerated weather)

WIRE CLOTH
Allegheny Steel Co.
Baker & Co. Inc.
J. Bishop & Co. Platinum Works
Eimer & Amend
B. F. Gump Co.
International Nickel Co. Inc.
Korb-Pettit Wire Fabrics & Iron Works
Newark Wire Cloth Co.
Robinson Mfg. Co.
John A. Roebling's Sons Co.
W. S. Tyler Co.

WOOD FLOUR EQUIPMENT
Robinson Mfg. Co.

WRINGERS
Tolhurst Centrifugal Div., American Machine & Metals (chip)

Compiled from information supplied to International Exposition Company
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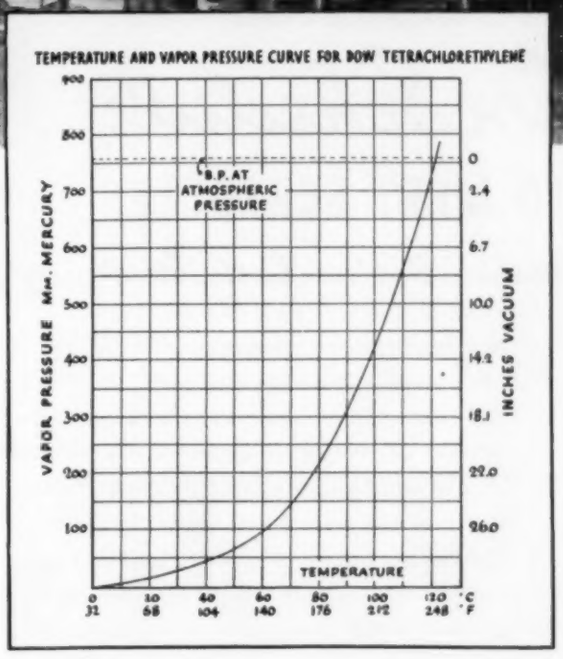
DOW PERCHLORETHYLENE

(TETRACHLORETHYLENE TECHNICAL)

Now produced in commercial quantities at a practical price

Dow



The constant aim of Dow is to devise production methods making chemical products available to a wider market through lower costs.

Many industries use solvents. And many manufacturers have been anxious to utilize the marked advantages of Perchlorethylene but have been prohibited due to uneconomic cost.

The boiling range (120.0 to 122.0° C.) permits its use at higher temperatures than other chlorinated hydrocarbons, thus increasing its solvent power.

It offers the greater safety of being nonflammable and noncombustible. A protection to plant, worker and insurance costs.

It is readily recovered so that losses are held to a minimum.

Through enlarged and improved production facilities Dow is able to offer this superior organic solvent at prices permitting its widespread use.

If you are a user of solvents let us give you detailed information on Dow Perchlorethylene and quote on your requirements.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

Branch Sales Offices: 30 Rockefeller Plaza, New York City—Second and Madison Streets, St. Louis—Field Building, Chicago—584 Mission Street, San Francisco—2260 East 15th Street, Los Angeles.

. . PRODUCERS OF OVER 300 CHEMICAL PRODUCTS . .

On Schedule

TO MEET SCHEDULES

North . . South . . East . . West

WHETHER your business is located in a small manufacturing town or a metropolitan center, the convenient locations of nearby stocks of Grasselli Chemicals assure exceptionally rapid delivery. Prompt delivery has become an important factor in the buying habits of industry and Grasselli Service has always kept abreast of this modern trend. Our plants and warehouses, carrying complete stocks of Grasselli Chemicals, are located in many cities throughout the country. There's one near you.

These well known chemicals include a full line of acids and heavy chemicals, metals, ores and plating chemicals, agricultural chemicals and chemical specialties. These products have long been known for purity, uniformity, and high quality—and, in addition, a *plus service:* offering technical assistance available to aid manufacturers in the use of Grasselli Chemicals.

Service, Quality, and Cooperation linked together make Grasselli Chemicals better meet industrial needs.

E. I. DU PONT DE NEMOURS & COMPANY, INC.
GRASSELLI CHEMICALS DEPT.
WILMINGTON, DELAWARE

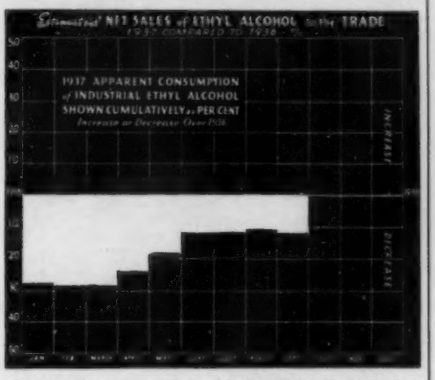
GRASSELLI CHEMICALS

ADVERTISEMENT—*This entire page is a paid advertisement.* *Prepared Monthly by the U. S. Industrial Chemical Co., Inc.*

SOLVENT NEWS

Reg. U. S. Pat. Off.

December ★ A Monthly Series of Articles for Chemists and Executives of the Solvent-Consuming Industries ★ 1937



Apparent consumption of industrial ethyl alcohol from Jan. 1 to Sept. 30, 1937, was 39,466,000 wine gallons. This is 11.5 per cent less than during the same period in 1936 when 44,579,000 wine gallons were consumed.

Claim Gelatin Improves Adhesion of Lacquers

PARIS, France—Production of cellulosic lacquers which have greater adhesion for paper, regenerated cellulose and materials which swell in water can be accomplished by incorporating in the lacquer a solid organic substance which is soluble in water but not soluble in the organic solvent of the composition, it is claimed in a patent granted here.

As an example, the patent papers suggest the following formula: nitrocellulose 60%, acetanilide 6%, benzoyl benzoic acid 10%, dibutyl phthalate 18%; 100-200 parts of this are dissolved in 100 parts of a solvent consisting of 16% butyl acetate, 10% ethyl acetate, and 74% toluene.

A second solution is prepared with 95% water and 5% gelatin. To 1,000 parts of the nitrocellulose solution are added gradually 3-7 parts of the gelatin solution, with vigorous stirring, until a dispersion of the aqueous gelatin is obtained.

More Cars Have Metallic Finishes At Auto Show

NEW YORK, N. Y.—While all of the glitter at the National Auto Show held here recently may not have been due to the metallic finishes on the cars, there was a noticeable increase in the use of this type of finish.

Many manufacturers of low-priced cars report so emphatic a demand for metallics that they will use them in every color with the exception of maroon, pale green and black. Although black continues to be the biggest seller, definite inroads on its position are being made by metallics, with brown and green securing a stronger foothold.

Last year SOLVENT NEWS reported body striping less in evidence. This year that trend is reversed to some extent. However, the decreased popularity of secondary colors, noted last year, was still more evident at this season's show.

Process Preserves Paper

Paper records can be permanently preserved at a very low cost, according to the inventor of a new chemical process for this purpose. Regardless of the age of the record, it is claimed that this process will strengthen the paper and maintain the legibility.

U.S.I. to Make Dry Ice in New Orleans

Erects New Plant To Solidify CO_2 From Alcohol Manufacture

NEW ORLEANS, La.—Manufacturing operations are now in full swing for the production of Dry Ice, the modern refrigerant that does not melt,* to supply New Orleans and the surrounding territory. Erected by the U. S. Industrial Alcohol Co. at Broadway and Coliseum St., the new Dry Ice plant is said to be the most up-to-date and compact unit of its type in the country.

Dry Ice is the trade name for solidified carbon dioxide—the gas resulting from fermentation of molasses in the manufacture of industrial ethyl alcohol.

In addition to its everyday use for the protection of frosted foods and ice creams, it finds an increasing market in industrial cooling equipment, special refrigerated freight cars and numerous chemical and scientific applications.

**Changes from a solid to a gas without passing through the liquid stage.*

100 U. S. I. Products at Chem. Show

NEW YORK, N. Y.—More than 100 products will be displayed by the U. S. Industrial Alcohol Co. and the U. S. Industrial Chemical Co., Inc., at the Exposition of Chemical Industries, Dec. 6-11. U. S. I. will occupy Booth 90 with Air Reduction Co. and affiliates.

Among the products to be shown by U. S. I. are important paint, varnish and lacquer solvents; dyestuff and pharmaceutical intermediates; and a group of unusual alcohol derived chemicals.

Diethyl Phthalate Solution Is Aid to Low-cost Blueprints

Process Makes Ordinary Paper Transparent For Blueprinting

BALTIMORE, Md.—U. S. I. Diethyl Phthalate, extensively used as a plasticizer for cellulose acetate and as a fixative in perfumes, will render ordinary paper sufficiently transparent for blueprinting, experiments at U. S. I. laboratories here have demonstrated. Any number of clean, distinct blueprints may be made from regular office records, sketches and similar material.

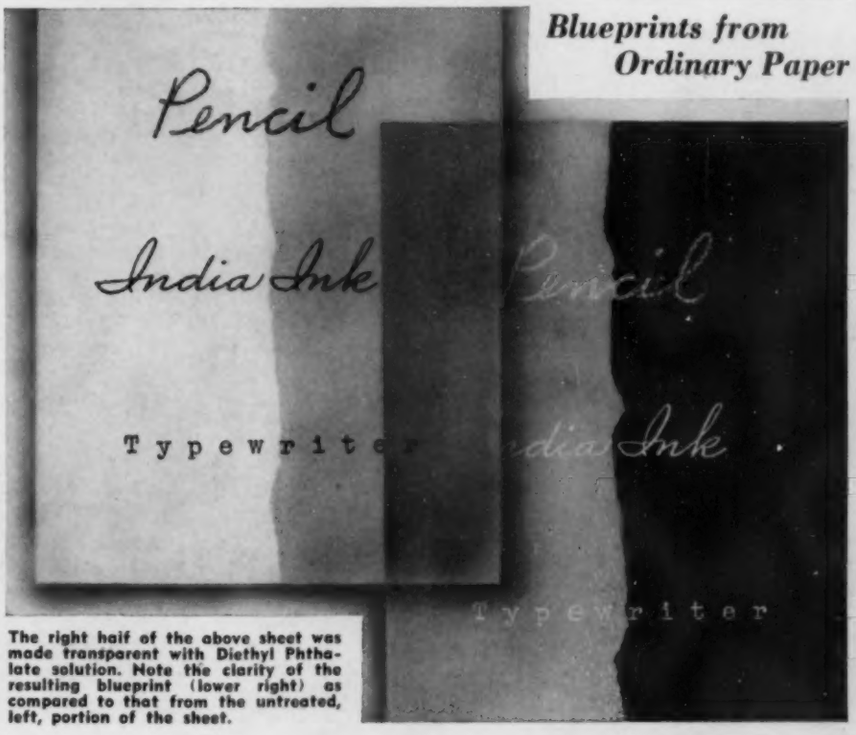
It was found that paper treated with 25% Diethyl Phthalate and 75% Solox (proprietary solvent of U. S. I.) became sufficiently transparent to transmit clearly the writing or drawing on it in the same manner as though the original writing had been made on tracing cloth.

Solox Solution Better

Preliminary tests were conducted with Diethyl Phthalate alone. While it proved possible to make blueprints from paper treated in this manner, further experiments showed a significant difference in favor of greater clarity when the Diethyl Phthalate-Solox solution was used in the proportion mentioned.

One important advantage of the method is its wide utlitity. Distinct prints can be produced from India ink, typewritten and even pencil originals. In general, however, India Ink yields the clearest copies. A comparison of the various prints is shown below.

(*Continued on next page*)



Blueprints from Ordinary Paper

The right half of the above sheet was made transparent with Diethyl Phthalate solution. Note the clarity of the resulting blueprint (lower right) as compared to that from the untreated, left, portion of the sheet.

More Uniform Plastics Needed For Aircraft Says Bureau of St'ds

WASHINGTON, D. C.—Experiments now being conducted to determine the suitability of plastics for aircraft windows demonstrate the need for more uniform materials, it was revealed in a recent issue of the *Journal of Research of the National Bureau of Standards.*

However, the results so far obtained are inconclusive, it was emphasized, because only three of the plastics—cellulose acetate, cellulose nitrate and acrylate resin—submitted by manufacturers were recommended for use on aircraft.

Acrylate Ranks High

Cellulose acetate was found to have excellent impact strength, bursting strength and flexibility, but was subject to warping and crazing after a year of weathering, the Bureau stated. Acrylate resin ranked high in transparency and scratch resistance, but was deficient in impact strength and flexibility, according to the Bureau.

No change was noted in a sample of cellulose acetobutyrate that had been exposed to the weather for 12 months.

Other transparent plastics, however, such as cellulose nitrate, ethyl cellulose, vinyl-chloride acetate and vinyl acetal failed in resistance to weathering after approximately three months, the Bureau points out.

Diethyl Phthalate Aid To Low-cost Blueprints

(*Continued from previous page*)

Of the ordinary methods for duplicating important records and memoranda, blueprinting is generally conceded to be the most economical. Compared with photostating, its cost is roughly half when single duplicates are to be prepared. For a larger number of copies this differential is even more striking so that, for example, the cost of a dozen blueprints is approximately one-third the cost of a corresponding number of photostats.

Engineers, chemists and superintendents may secure further information on this process by writing to the U. S. Industrial Chemical Co., Inc.

Paint Material Exports 24% Above 1936 Period

Exports of American paint materials during the first three-quarters of 1937 were valued at $16,320,000, a gain of 26 per cent over the same period in 1936, according to C. C. Concannon, Chief of the Commerce Department's Chemical Division.

Ready-mixed paints, varnishes and lacquers enjoyed the same per cent increase to reach a value of $6,193,600, the department reports.

Shipments of chemical pigments are said to have been especially heavy due to a better demand for carbon black. During the first nine months of this year 164 million pounds, valued at $8,743,500, were shipped as compared to 128 million pounds, $6,845,000, in the same months of 1936.

Fluorescence Is Newest Tool For Paint Analysis

CINCINNATI, Ohio—A new approach to the problem of rapidly identifying some of the more important raw raterials used in paints and lacquers is fluorescence analysis, delegates at the recent convention of the National Paint, Varnish and Lacquer Ass'n. were told.

This same method, it was pointed out, has already been used with success in the examination of food products, drugs and cosmetics, and the results of eight months' experiments with paint materials have emphasized that it may become increasingly useful.

It was reported that although solvents and plasticizers, exposed to light from a quartz-mercury lamp, fluoresce only slightly, or not at all, resins exhibit characteristic emissions which make it possible for an experienced observer to differentiate between them.

White pigments can be definitely identified, the experimenters declared. Additional tests, they stated, indicate that bodied oils can be differentiated from raw oils by their greater fluorescence, and that chinawood oil can be differentiated from perilla and linseed.

To permit safer blasting operations in mines while miners are at work, mechanical substitutes for blasting powders are being used. This was reported in a recent article which also states that one of the substitutes is compressed carbon dioxide, a by-product of alcohol manufacture.

TECHNICAL DEVELOPMENTS

Further information on these items may be obtained by writing to U.S.I.

A heat-indicating ink changes from red to black when heated and back to red on cooling, according to the manufacturers. It is suggested that the ink be used for labels on parts not readily painted with heat-indicating paint. **(No. 41)**

U S I

A new wetting agent for water, said to be 5 to 10 times more efficient than other commonly used wetting agents, can be used in hard water or acid solutions where soaps are not effective, according to its manufacturer. Its application on wall paper is said to cause the paper to release its hold on a wall almost immediately. **(No. 42)**

U S I

Two new self-emulsifying waxes said to be particularly suitable for making bright-drying finishes, are reported to dry to hard, transparent, glossy and waterproof films. Emulsification is accomplished, according to the manufacturers, by simply melting the wax and adding boiling water with agitation. Shellac or special resins may be added, it is stated. **(No. 43)**

U S I

A binder for aluminum flake is reported to blend readily with common aluminum paint vehicles and to accelerate drying. Paints formulated with this binder, according to the manufacturer, will not skin in the open package and are exceptionally elastic and water-proof. **(No. 44)**

U S I

A new lu...escent paint, said to be non-toxic, can be applied by brush or by air-gun, according to a recent announcement. It is claimed that this paint will glow in the dark for about twelve hours after it has been exposed to the light and, on being re-exposed for 20 to 30 seconds, will "re-charge." **(No. 45)**

U S I

A new valve (or faucet) for metal and glass containers is said to eliminate the need for a vent. The manufacturer states that the valve can cut a hole in a sealed metal can and be screwed in air-tight and leak-proof. **(No. 46)**

U S I

A paint primer for metal is reported to penetrate rust and make it chemically inert, expel moisture and prevent further rust. Paint or oil enamels may be applied over it, but not lacquers or synthetics, it is stated. **(No. 47)**

U S I

Special labels for difficult surfaces were announced recently. The manufacturer says they will stick to aluminum, to printed and to other unusual surfaces and no special moistening solution is required. **(No. 48)**

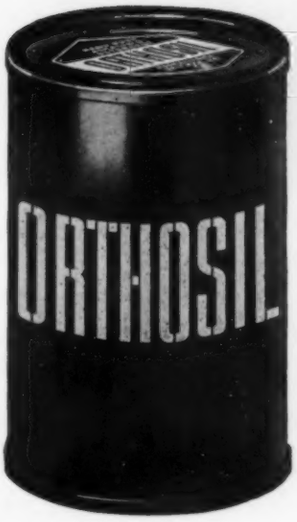
U S I

A new type of roll leaf for stamping and embossing, recently announced, is made on a web of transparent cellulose for flexibility and adaptability. According to the manufacturer it is available in gold-bronze, aluminum and pigment colors and is suitable for box tops, leather articles, wood handles, plastics, etc. **(No.49)**

ORTHOSIL

TRADE MARK

Blasts off the dirt and oil in electrolytic metal cleaning



ORTHOSIL solutions are better conductors of electricity than those of almost any other alkaline salt in similar concentrations. The notably low surface tension of Orthosil solutions enables them to penetrate beneath the dirt and oil film on the surface of the metal being cleaned.

These solutions get into the pores of the metal . . . making contact and generating bubbles of gas in copious quantity. Grease and dirt are lifted violently from the metal during electrolytic cleaning . . . literally blasted into the Orthosil solution.

Orthosil is an *anhydrous* granular material unhampered by inert salts and relatively weak alkaline diluents. In the heavy-duty cleaning of metals it is outstanding for its quick action. Try Orthosil . . . check its advantages against those of any other industrial detergent. Write for full details — address Department B.

1. **Particularly efficient in electrolytic cleaning due to its high conductivity.**
2. **Assures quicker action than other alkalis.**
3. **Prevents grease and dirt from re-depositing.**
4. **Easy to pour, quick to dissolve.**
5. **Anhydrous—highly concentrated—economical.**
6. **Quickly removes the grease, soot, dust, and various kinds of dirt unaffected by pickle acid.**
7. **Leaves material *clean* for further processing.**

TRADE MARK

PENNSYLVANIA SALT MANUFACTURING COMPANY · Est. 1850

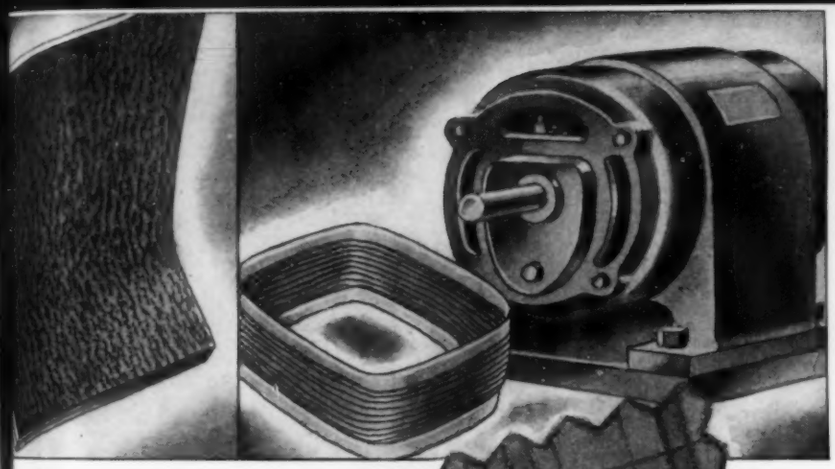
Widener Bldg., Philadelphia, Pa.

Offices: New York · Chicago · St. Louis · Pittsburgh · Tacoma · Wyandotte

PENNSYLVANIA SALT *Chemicals*

METHACRYLATE RESINS

manufactured by Du Pont



ESIVE: A surprisingly small ...tion produces high adher... ...wood to metal, metal to metal, ... to paper, etc.—in melt, lac... or emulsion form.

• • •

CTRICAL: For impregnating ...il coils, insulation of wire, ...n of insulation to wire. Also ... as an insulator itself.

TEXTILE: These resins are used for the lamination of cloth; stiffening of paper, cloth and felt; as a resistant to oils, water, alkalies, etc.

...WOOD: Impregnation ...r increased strength ...d higher insulation of ...wood; reduced water ...sorption; resistance to ...rpage and action of ...hemicals; also for—

COATING: Clarity, light resistance, water impermeability, resistance to alcohols, oils, alkalies and acids suggest many coating applications; e. g., for metals.

METHACRYLIC ACID derivatives have been known to chemistry for many years. It is only recently, however, that their wide range of possible applications has been realized. Now, after years of laboratory development and research, Du Pont announces them for commercial use.

They are adaptable to almost every industry. Although scores of uses have already been found, it remains for the industrial chemist to realize the full versatility of these products, applying them to individual problems—so numerous that any attempt to list them all would be futile.

The economy of methacrylate resins is twofold:

1 – *The initial cost* is sufficiently low to permit wide experimentation and easy adaptation to various industrial needs.

2 – Their specific gravity of only 1.05—1.19 permits *coverage of a greater area per unit of weight* than is usually achieved by other synthetic resinous materials used in coating composition formulation.

FOR FURTHER INFORMATION, WRITE–

E. I. DU PONT DE NEMOURS & CO., INC.

AMMONIA DEPARTMENT

WILMINGTON, DEL.

DU PONT

REG. U. S. PAT. OFF.

...TTER THINGS FOR BETTER LIVING ... THROUGH CHEMISTR...

"New opportunities for chemists—"

"New agents for conditioning—"

"New possibilities for products—"

"New ideas—"

"What does it all mean?"

"New terms in chemistry—"

What about this term, "HUMECTANT RANGE"

According to the dictionary—humectant means "affinity for water." A product with humectant qualities tends to take on moisture when the atmosphere is humid.

But humectant qualities vary widely. Some chemicals not only take on moisture under humid conditions, but tend to discharge moisture when the atmosphere becomes dry. Such chemicals therefore have a "wide humectant range" which sounds well, perhaps, but is unfavorable in that it indicates instability or a wide range of fluctuation in moisture content.

A narrow humectant range on the other hand, indicates stability of moisture content. Sorbitol, for example, is a moisture content stabilizer. This is to say—Sorbitol tends to take on moisture to a lesser degree at high humidities but, conversely, tends to lose less moisture at low humidities.

Now that Atlas Sorbitol is available in commercial quantities, the industrial chemist has opportunities to make use of this humectant stabilizing power to a degree of advantage hitherto impossible to attain. This is especially true in conditioning textiles, leathers, papers, glues or cellulosic products.

ATLAS
SORBITOL

Atlas Sorbitol — a hexahydric alcohol—is a logical scientific development that broadens the usefulness of conditioning agents.

The Atlas commercial grade has these outstanding properties:

HIGH VISCOSITY
NON-VOLATILITY
NARROW HUMECTANT RANGE

CHEMICALS ATLAS EXPLOSIVES

INDUSTRIAL CHEMICALS DEPARTMENT

ATLAS
POWDER COMPANY
Wilmington, Delaware

The More Power to Him!

A CHANCE visitor might attribute C. J. Dorst's passion for keeping everything "just so" to temperament or to plain fussiness. But as power plant operator at Mathieson's Lake Charles plant, Dorst's job carries responsibilities which call for precisely this sort of thoroughness.

For not only must power service throughout Mathieson's plant be continuous. Its output must be closely controlled; voltage and frequency must be kept within narrow limits; generators must be accurately synchronized. Only in this way can Mathieson take full advantage of the low-cost raw materials and fuel at Lake Charles, and translate these into outstanding quality for its products.

Mathieson's generating equipment at Lake Charles comes as close to perfection as the rest of the units in this modern alkali plant. Yet all this equipment would mean little to you were it not for the supervision of men like C. J. Dorst. In large measure, it is these men—faithfully handling hundreds of "big little" jobs—who make Mathieson an organization to which you can look with unwavering confidence.

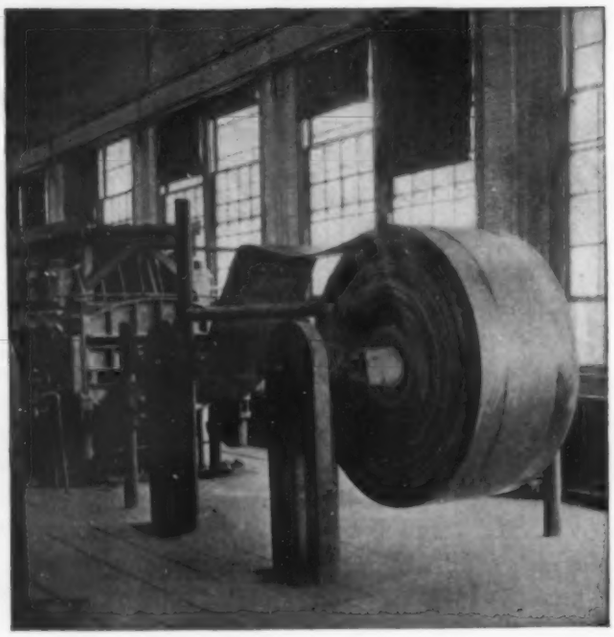
The MATHIESON ALKALI WORKS (*Inc.*)
60 East 42nd Street New York, N. Y.

Soda Ash . . . Caustic Soda . . . Bicarbonate of Soda . . . Liquid Chlorine Bleaching Powder . . . HTH and HTH-15 . . . Ammonia, Anhydrous and Aqua Pll-Plus (Fused Alkali) . . . Sulphur Chloride . . . CCH (Industrial Hypochlorite) Dry Ice (Carbon Dioxide Ice)

Mathieson Chemicals

SULPHUR AND RUBBER

WHEN Charles Goodyear accidentally dropped some India rubber mixed with Sulphur on a hot stove, he started something! The huge rubber industry as we know it today—belting, tires, hose and hard rubber products—all developed from that little accident. Later, chemists discovered the reason why Sulphur helped so much. It is an indispensable product, even though the percentage required is not always high. The story of rubber emphasizes the part Sulphur plays in industry. Sulphur, the converter, in one form or another changes many raw materials into basic useful products. Sulphur is indeed one of the "keystones" of today's chemical engineering.



Texas Gulf Sulphur maintains a steady production of more than 3000 tons daily of 99½% pure Sulphur. Ample stocks are available at the mines and shipping point—Galveston—to take care of cargo or carload orders.

TEXAS GULF SULPHUR CO.
75 E. 45th Street New York City
Mines: Newgulf and Long Point, Texas

RADIUM··

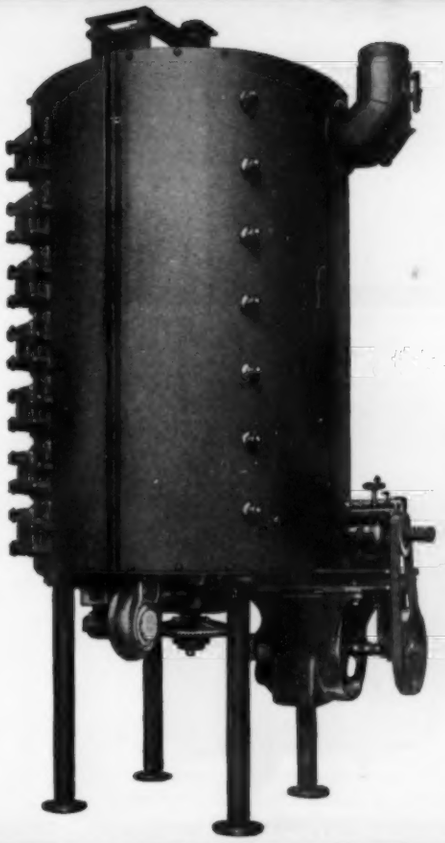
A Bethlehem Roaster helps extract it from World's Richest Ore · · ·

Eldorado—mining sensation of modern times—plans tripled production. This operation that mines the radium, silver and uranium bearing pitchblende 24 miles north of the Arctic Circle, concentrates it and ships it by boat, plane and rail 4,500 miles to the Port Hope, Ontario, refinery.

To assist in the processing of this, one of the most complex ores, a small Bethlehem Roaster will be employed, treating less than 5 tons of concentrates per day under the expanded production program, planned for the recovery of three ounces of Radium per year worth from $2,000,000 to $2,500,000, as well as very valuable amounts of silver and uranium.

The Bethlehem Roaster purchased for Port Hope is a modified laboratory scale model primarily designed for research and pilot plant operation—many times smaller than the giant commercial Bethlehem Roasters widely used throughout the Metallurgical and Chemical Industries.

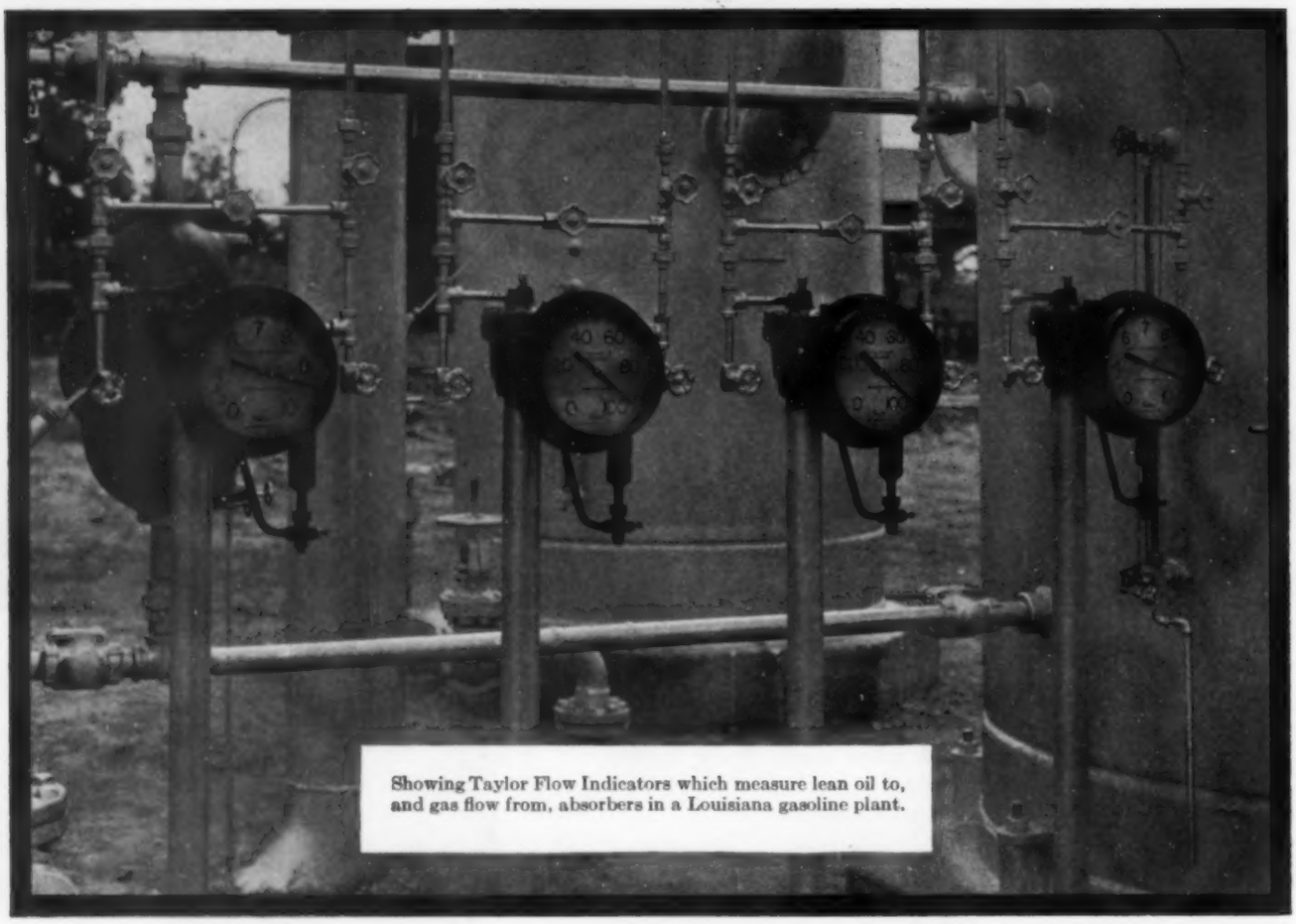
However, it employs the same distinctive Bethlehem features which provide: accurate control of rate of feed, rabbling, time of roast, roasting temperatures, and amount of oxidizing air. Features equally important to profit in large volume recovery of relatively low value "waste" materials, as in the refining of precious metals and rare elements.



BETHLEHEM

BETHLEHEM FOUNDRY
& MACHINE COMPANY, BETHLEHEM, PA.

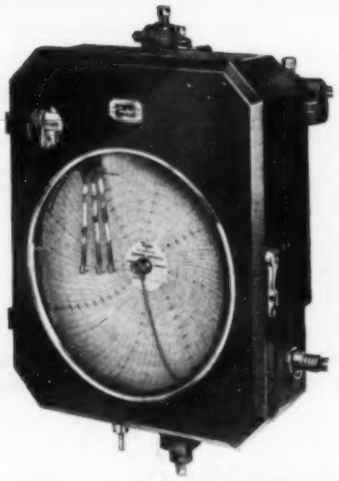
FOR LIQUID...



Showing Taylor Flow Indicators which measure lean oil to, and gas flow from, absorbers in a Louisiana gasoline plant.

TAYLOR FLOW RECORDER. Single-pen type to record rate of flow directly, or differential pressure. Two- and three-pen types for differential pressure and static pressure and/or temperature.

TAYLOR FULSCOPE INDICATING FLOW CONTROLLER for liquids . . . or for gases and steam under constant pressure. Completely adaptable to operating conditions and processing needs.



TAYLOR INTEGRATING FLOW RECORDER. Contains standard Taylor Flow Recorder with integrating mechanism. Pressure-compensated or uncompensated types available.

GAS..STEAM

There's a Taylor Flow Meter to measure or control rate of flow with proved accuracy, efficiency, durability and economy in operation

Send for Special Taylor Catalog 70J—one of the most complete books on Flow (and Liquid Level) instruments ever printed . . .

WHAT TYPE of instruments do you need for measuring or controlling rate of flow in your plant? Is it a comparatively simple matter of indicating or recording flow of a liquid . . . a gas . . . or steam? Is it a complex job of control?

No matter what your specific requirements are, you can make a selection of the correct instrument from the complete Taylor line. In these instruments you will find the modern refinements and improvements necessary to meet the severest demands in regulating continuous processes. You can be sure of the same accuracy, dependability, and economy that you obtain from Taylor Temperature and Pressure Instruments.

The many years of accurate, trouble-free service assured by Taylor Flow Meters help to make life easier and happier for a plant's management, its engineers and its foremen. The primary devices of these instruments are time-proved in principle and in actual operation. The secondary or measuring devices are standard Taylor Instruments with the outstanding features and advantages that have been known to major industries for a long, long time.

Taylor Flow Meters include the following:

DIAL TYPE INDICATORS . . . for liquids, or for gases or steam under constant pressure.

RECORDERS . . . single-pen types for liquids—two- and three-pen types for gases and steam.

INTEGRATING RECORDERS...for liquids—or for gases and steam.

CONTROLLERS . . . single-pen types for liquids—two- and three-pen types for gases and steam.

TIME-SCHEDULE CONTROLLERS; RESET CONTROLLERS; INDICATING FLOW CONTROLLERS and other types that you will see in Catalog 70J.

You really should have this Taylor Catalog 70J in your file. It is one of the most complete books on flow instruments ever put out by a manufacturer of instruments. (It tells about Taylor Liquid Level instruments, too.) It is so complete that in many cases you can select the instrument you need without any further inquiry. For this catalog and any help on control problems, ask a Taylor Representative, or write direct to Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada. Manufacturers in Great Britain—Short & Mason, Ltd., London, England.

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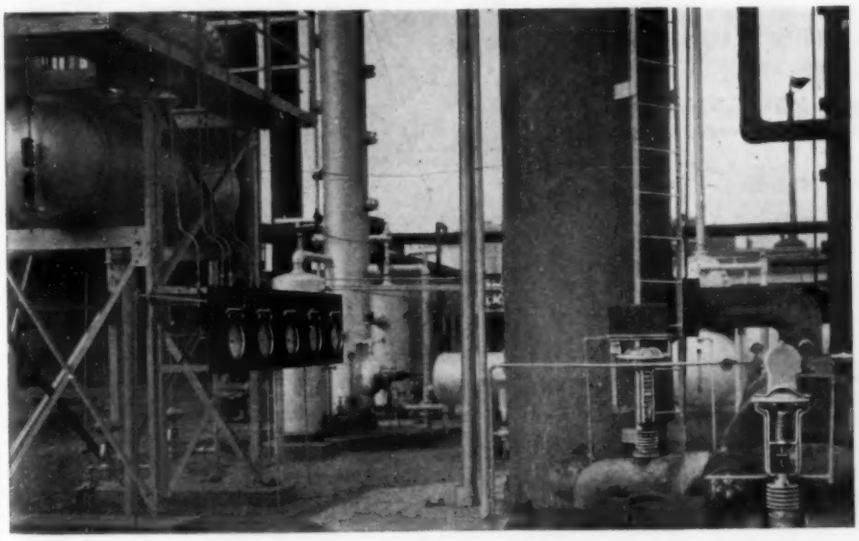
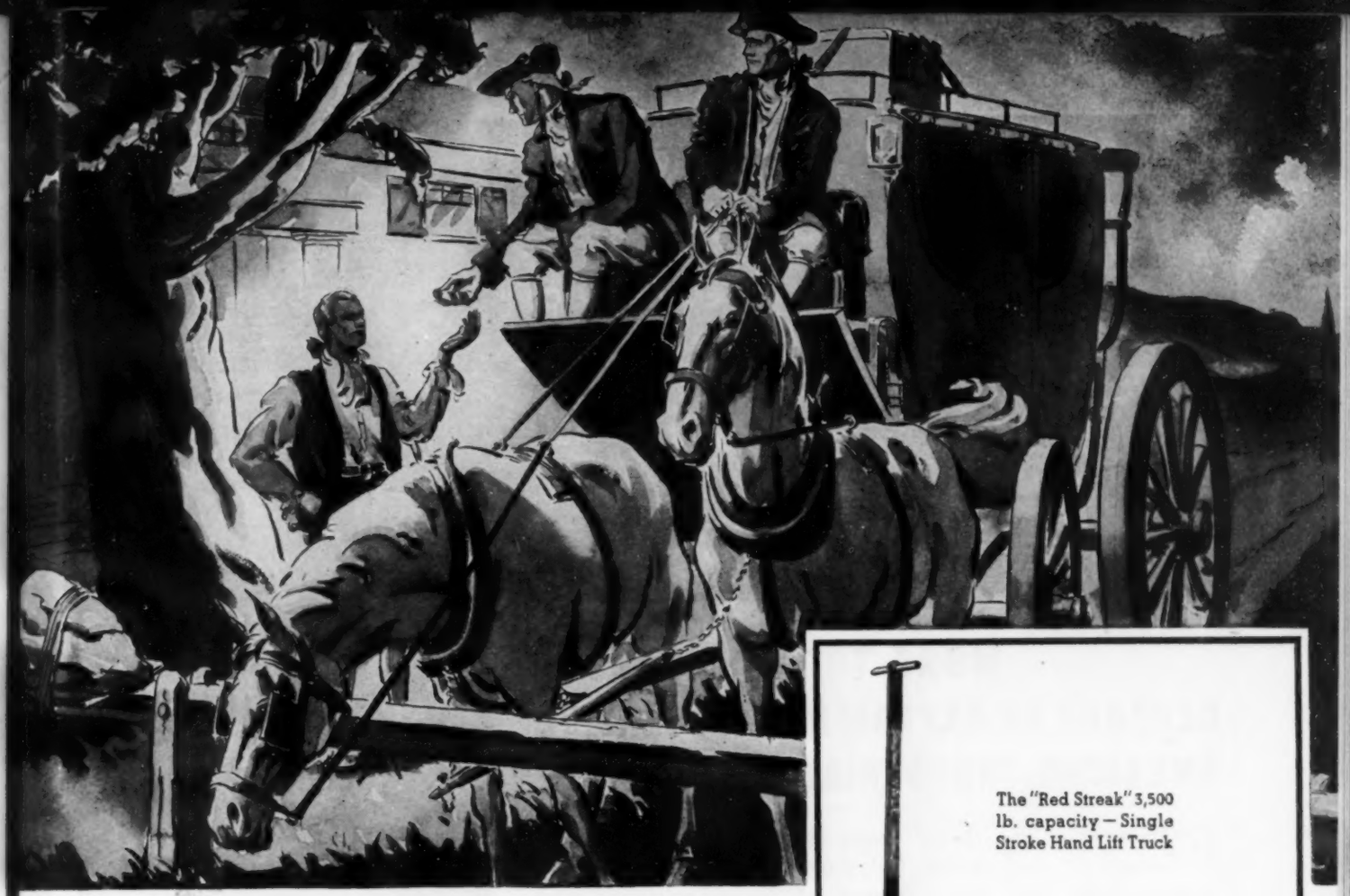


Panel board with Taylor Fulscope Flow and Temperature Controllers in a large plant in Oklahoma.

Taylor

Indicating Recording Controlling

TEMPERATURE, PRESSURE, FLOW *and* **LEVEL INSTRUMENTS**



BEWARE THE *Toll of Tradition* ..GO MODERN WITH YALE HAND LIFT TRUCKS

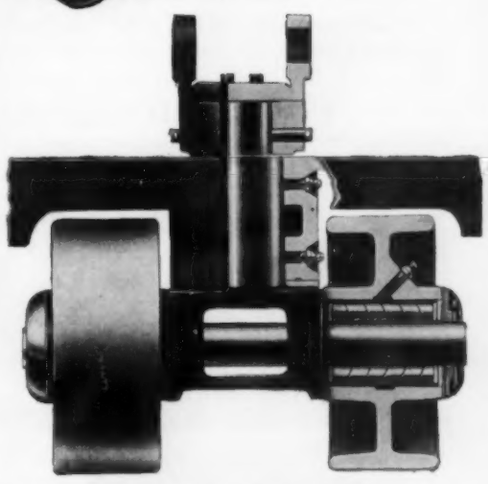
It's not so long ago that lumbering stagecoaches clattered over the highways, paying tribute at every toll gate. The most efficient mode of travel then known—*NOW* relics of a picturesque past . . . Because time works changes that make the efficiency of yesterday ineffectual today.

That's the price of progress—the reason that materials handling methods which may have brought results for years, fall down when compared to modern systems. One simply has to keep up with the times or pay the Toll of Tradition—excess overhead that bites deeply into profits.

Perhaps therein lies the answer to YOUR cost problem. If so, you can solve it with Yale.

The *YALE HAND LIFT TRUCK AND SKID PLATFORM SYSTEM* is the most modern in its field. It combines the four features of Safety—Speed—Efficiency—and Economy to the Nth degree . . . Brings you the mechanical features of tomorrow—TODAY.

The "Red Streak" 3,500 lb. capacity — Single Stroke Hand Lift Truck



RUGGED FRONT END CONSTRUCTION — Front wheels equipped with over-capacity roller bearings mounted on axle of high carbon chrome manganese steel. Axle key eliminates wear—hardened steel thrust washers on either side of wheels assure maximum life.

LET OUR REPRESENTATIVE TELL YOU MORE ABOUT THE YALE LINE

TRADE YALE MARK

THE YALE & TOWNE MANUFACTURING COMPANY
PHILADELPHIA DIVISION, PHILADELPHIA, PA.
IN CANADA: ST. CATHARINES, ONT.

Doc. *Steelstrap* BRINGS THE HOLIDAY SPIRIT

TO THE PACKING AND SHIPPING DEPARTMENTS

● A yuletide gesture that Doc. Steelstrap enjoys the year around is the distribution of shipping economies. As a result of his system, management receives consumer satisfaction and lower shipping costs. The sales department gets safer shipping. The traffic department receives lower packing costs, lighter weight containers and a larger output per man. And the company gets bigger profits.

Doc. Steelstrap is generous. He would like to bestow such presents on *your* organization. All he asks is a chance to diagnose your present packing and shipping methods. Nine chances out of ten he'll be able to suggest a system which will provide economies—not just at Christmas time but every month, in fact, every time you make a shipment.

All that is necessary is to mail the coupon below. The Doc. will do the rest. And if you haven't read "My Second Strap-Book" send for your copy today. It contains a lot of important information about packing and shipping.

ACME STEEL COMPANY
GENERAL OFFICES:
2851 Archer Avenue, Chicago, Ill.

Branches and Sales Offices in Principal Cities

ACME STEEL COMPANY, 2851 Archer Ave., Chicago, Ill.

☐ Mail a free copy of "My Second Strap-Book."

☐ Mail full particulars about a free "diagnosis" by Doc. Steelstrap.

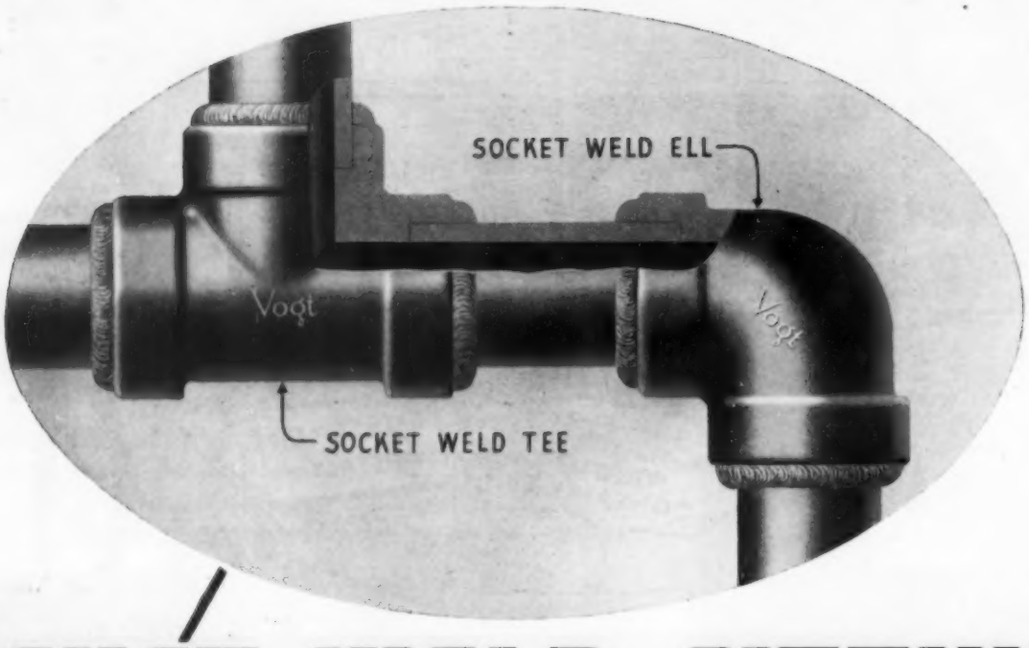
Name _____

Address _____

City _____ *State* _____

now!

DROP FORGED STEEL



SOCKET WELD FITTINGS

by

Vogt

Easy to weld.. Stronger.. Safer

That same "drop-forge" quality, heretofore obtainable only in Vogt screwed fittings, is now available in Vogt Socket Weld Fittings. The material in these fittings is uniform in structure, fine grained and free from porosity. Because of the similarity of materials in fittings and pipe, it is easy to obtain sound welds.

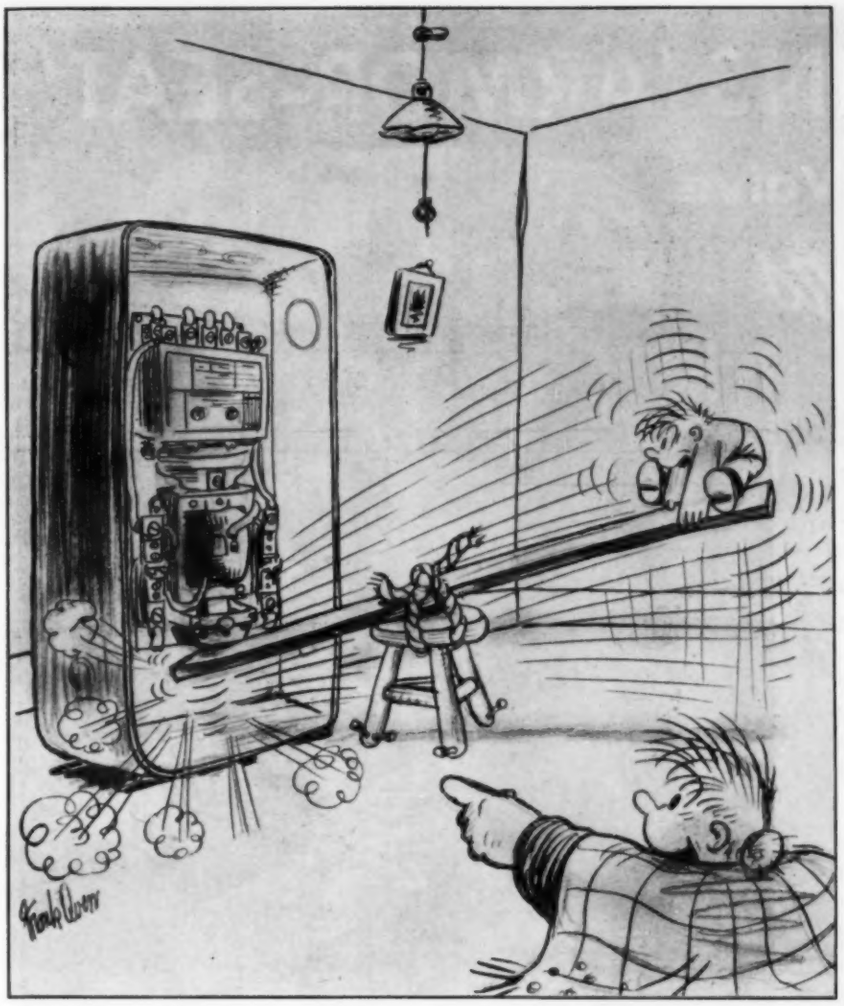
Vogt Socket Weld Fittings offer these distinctive advantages;

1. Socket for pipe assures positive alignment before and after welding.
2. No weld "icicles" can clog pipe interiors.
3. Bore of fittings matches I. D. of pipe.
4. Extra margin of strength and safety because they are DROP FORGED BY VOGT.

Available from stock in a full range of sizes.

HENRY VOGT MACHINE CO., *Incorporated* LOUISVILLE, KY.

NEW YORK • CHICAGO • CLEVELAND • DALLAS • PHILADELPHIA • KANSAS CITY



"So you like that up-and-down motion, Philbert?"

Philbert is not the only one who likes the Allen-Bradley solenoid starter's up-and-down motion. Engineers everywhere agree with Philbert. They like it because it has no trouble-causing hinges, pivots, and pins, and practically eliminates contact rebound. They prefer the double break, silver alloy contacts which never require filing and which outlast many ordinary contacts. In the chemical and process industries, where operating conditions are bad, the Allen-Bradley solenoid starter is ideal. Its simple, rugged construction provides long, trouble-free life. There is an Allen-Bradley solenoid starter for every process industry service. Write for 24-page booklet, "The Story of the Solenoid Starter."

Allen-Bradley Company A-B 1337 S. First St., Milwaukee

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

Special Enclosures for the Process Industries

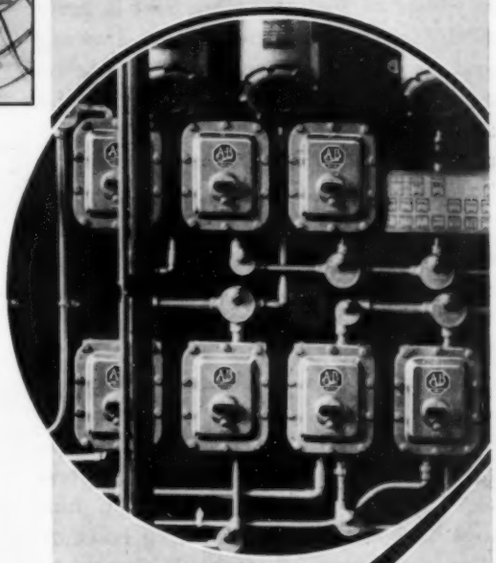
Water-Tight
Type B (NEMA Type 4) cadmium plated heavy cast-iron enclosure with rubber gasket.

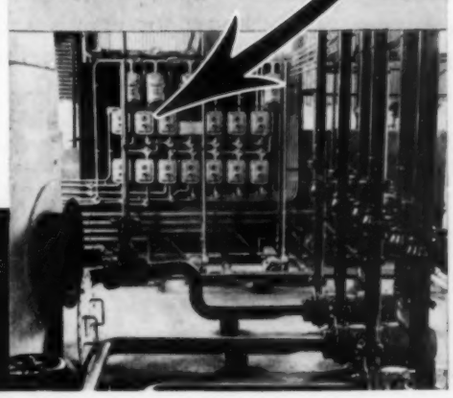
Dust-Tight
Type D (NEMA Type 9) dust-tight enclosure for hazardous combustible dust.

Corrosion-Proof
Type J oil-immersed starter with cadmium plated enclosure for use with corrosive gases.

Explosion-Proof
Type G (NEMA Type 7) cast-iron enclosure for Class 1, Group D, explosive gases.

BELOW—A group of explosion-proof Bulletin 709 solenoid starters in a southern alcohol plant.





TRAYLOR
ROTARY DRYERS

WE BUILD

BURNERS
ROTARY KILNS
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ROTARY DRYERS
ROTARY SLAKERS
SCRUBBERS
EVAPORATORS
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BALL MILLS
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TUBE MILLS
PUG MILLS
WASH MILLS
FEEDERS
ROTARY SCREENS
ELEVATORS

Welded or Riveted Stacks, Tanks and Bins for any purpose.

● Our photograph shows a full-welded, special-purpose Traylor Rotary Dryer made of "stainless" steel, and is typical of what our extensive business in this class of equipment has always been. We have built "standard" and "special" dryers in large numbers, but in a sense all of them have been "built to order", in that the design has been made to suit the ideas of the purchaser in every case.

● We have combined such features with the principles of design and construction that our wide experience has proved will insure high efficiency and economy of operation and maintenance. All of which is why Traylor has maintained leadership in this field for many years.

● We are certain that we can save YOU money on YOUR drying problem, of whatever nature it may be. A strong statement?—well, maybe, but we'll prove it, if you'll talk it over with our expert for an hour! *Why not write us today?*

TRAYLOR ENGINEERING & MANUFACTURING CO.
ALLENTOWN, PENNSYLVANIA, U.S.A.

NEW YORK CITY, 3916 Empire State Bldg. · CHICAGO, 815 One La Salle St. Bldg. · SALT LAKE CITY, 101 West Second South St. · LOS ANGELES, 919 Chester Williams Bldg. · SEATTLE, 6311-22nd Ave., N. E.

THE CANADIAN FAIRBANKS-MORSE CO., LTD., 930 St. Antoine St., Montreal, P. Q., Canada · B. C. EQUIPMENT CO., LTD., 551 Howe St., Vancouver, B. C.

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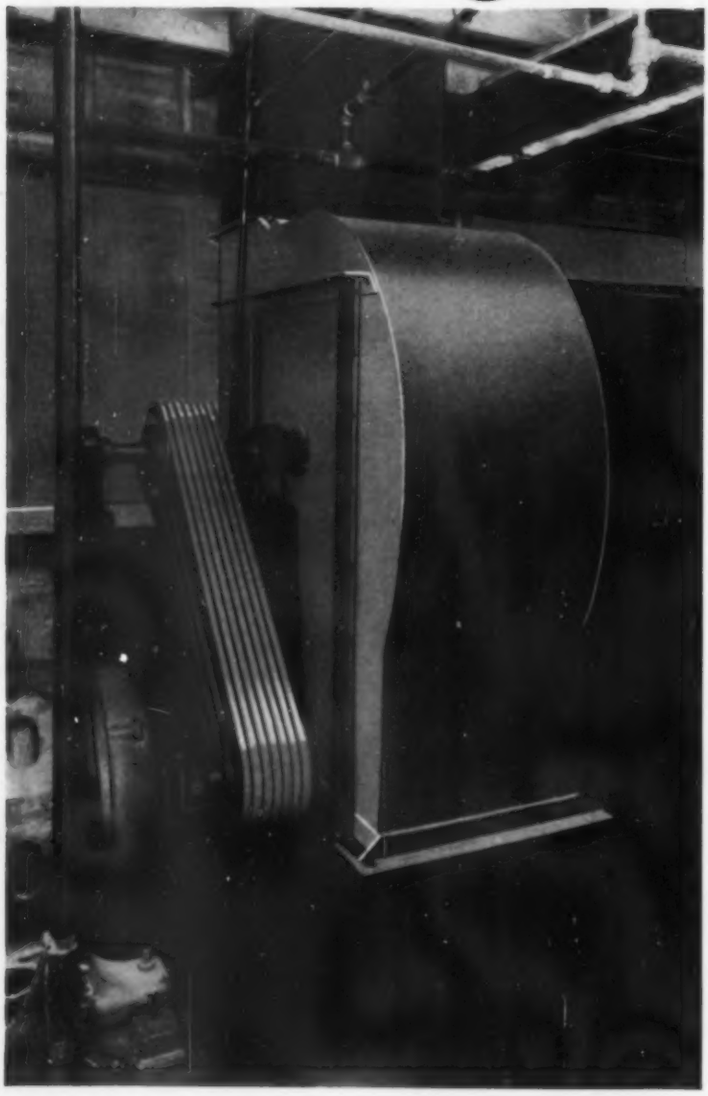
European Works—Usines Carels Freres, Ghent, Belgium

Do CORROSIVE FUMES Eat up your Ordinary Fans like Moths eat the old Bathing Suit?

A "Buffalo" 80" Rubber-lined Exhaust Fan handling highly corrosive fumes of hydrochloric acid. Fan has been in continuous operation for over 5 years.

You can out-smart the fumes with



"Buffalo"

RUBBER-LINED EXHAUSTERS

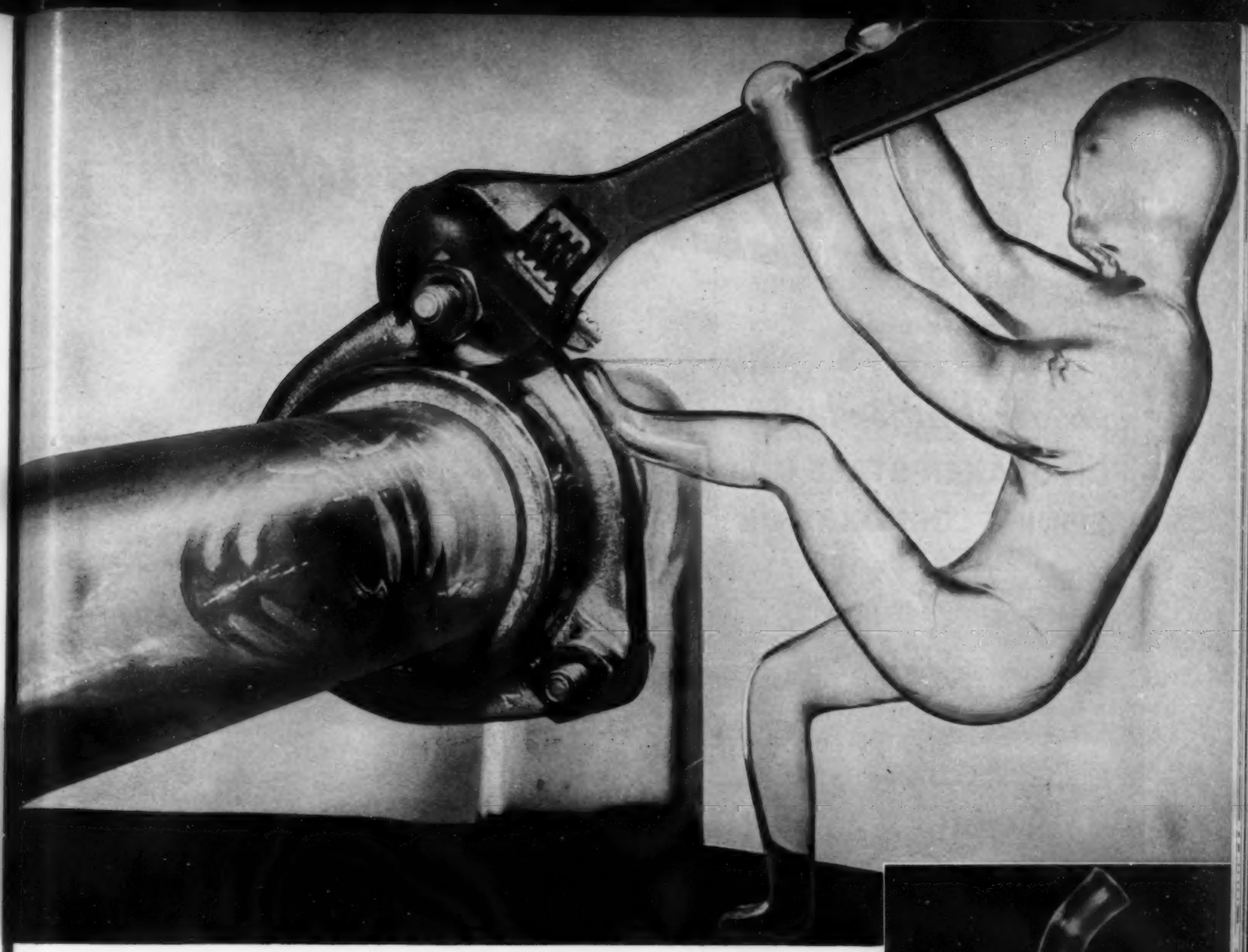
• Performance records of "Buffalo" Rubber-Lined Fans show that these specially designed fans outlast ordinary fans from 3 to 12 times in the exhausting of corrosive fumes.

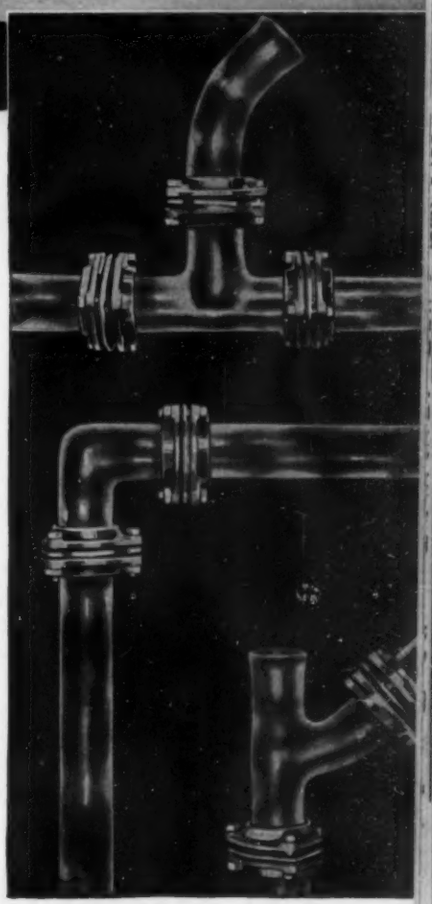
Entire inside of fan housing and fan wheel are lined with pure, live, soft gum rubber, applied by the "Vulcalock" method of the B. F. Goodrich Co. Its adhesive strength is over 700 lbs. to the square inch.

Why not reduce your acid fume handling costs by installing these proven "Buffalo" Rubber-Lined Exhausters.

Write for Bulletin 2424-C.

BUFFALO FORGE COMPANY
501 Broadway **Buffalo, N. Y.**
Branch Engineering Offices in Principal Cities
In Canada: Canadian Blower & Forge Co., Ltd., Kitchener, Ont.





Install LABORATORY CLEANLINESS IN YOUR PLANT

"PYREX" Brand Glass Equipment in the plant insures laboratory results on a mass production scale. Corrosion, contamination and catalysis can't upset the methods devised in the laboratory when products are protected by "PYREX" Brand Chemical Glass. It has remarkable resistance to all acids and alkalies in solution, except concentrated HF.

Laboratory control of production is also furthered through the transparency of "PYREX" Brand Glass which permits visual inspection at all times. Its trouble-free performance means lower ultimate costs.

"PYREX" Brand Chemical Glass in laboratory, pilot plant and plant assures a standardized product.

TM. REG. PYREX U.S. PAT. OFF.

PYREX

CORNING GLASS WORKS

CORNING N. Y.

"PYREX" is a registered trade-mark and indicates manufacture by Corning Glass Works

GLASS REVEALS BOTH ITS MAKE-UP AND ITS CONTENTS

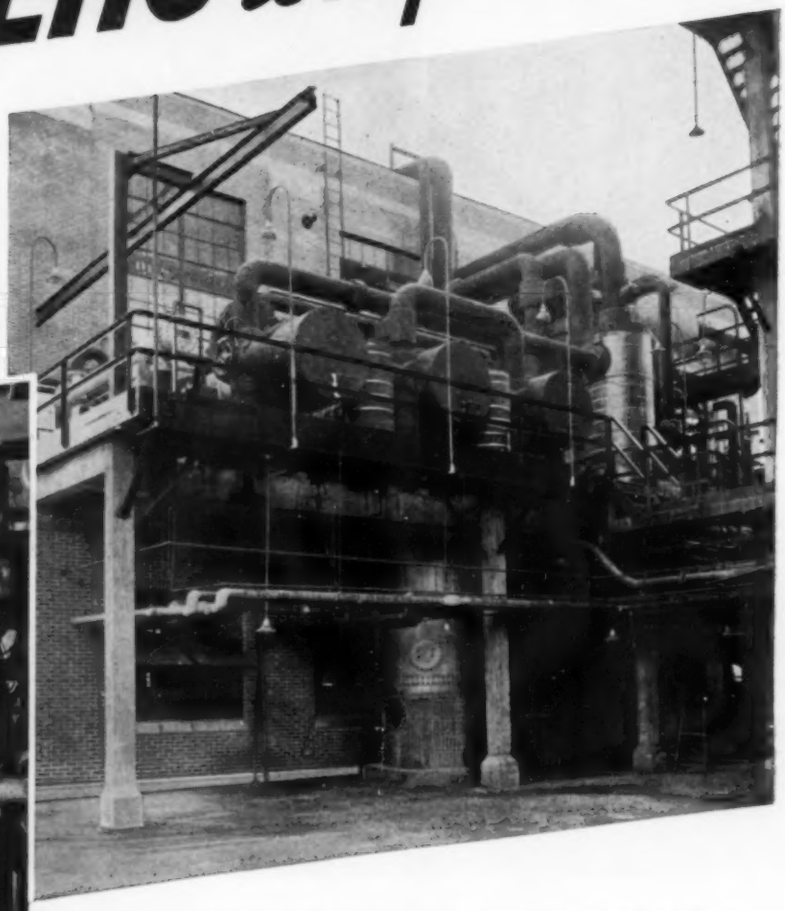
CORNING *means* Research in Glass

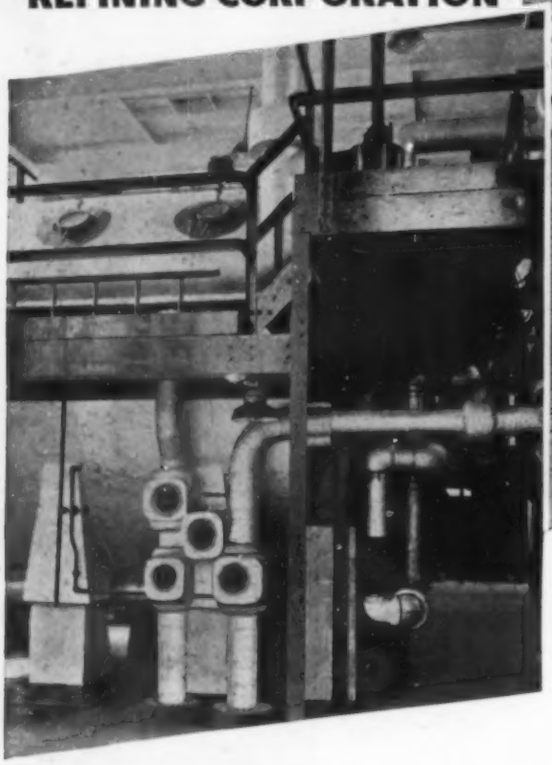
At SUB-ZERO temperature

CORK

cuts refrigeration losses

FOR QUAKER STATE OIL REFINING CORPORATION





THE PICTURE ABOVE *shows flue gas chillers and connecting pipe lines in the Quaker State Oil Refining Corporation's McKean plant at Bradford, Pa. Armstrong's Special Thick Cork Covering, with weatherproof finish, was installed by the insulation contractor, Laco Roofing and Asbestos Co. for E. B. Badger & Sons Co., Engineers, Boston.*

AT LEFT *is shown one of three Vallez Continuous Filters. Solvent and cold oil lines and fittings insulated with Armstrong's Special Thick Cork Covering. Filter temperature is −15° F.*

THE new solvent dewaxing processes demand accurate temperature control. This control is essential for the production of high quality lubricants. Process lines and equipment installed recently in the Quaker State Oil Refining Corporation's McKean plant, Bradford, Pennsylvania, are insulated for temperatures from −15° F. to −40° F. The insulation used is Armstrong's Cork Covering and Corkboard.

Leading refiners standardize on cork for two reasons: First, Armstrong's Cork Covering offers highly efficient insulation. Its low coefficient of thermal conductivity means that this insulation provides an effective barrier to the passage of heat, thereby preventing refrigeration loss. Second, cork possesses exceptionally long service life. Properly installed on the lines, Armstrong's Cork Covering will last through many years of heavy duty service. An important reason for this lasting efficiency is that cork naturally resists the moisture which is invariably encountered in low temperature insulation work.

Accurate inside diameters of Armstrong's Cork Covering assure a snug fit, with no pockets where moisture can collect. Because it is rigid, this insulation cannot sag away from the line. In 36-inch lengths, it is made in sizes to fit any standard pipe from ¼ inch up. Three standard thicknesses are available, with special thicknesses for extra low temperatures. For complete details, write Armstrong Cork Products Co., Building Materials Div., 919 Concord St., Lancaster, Pa.

Armstrong's CORK COVERING

ARMSTRONG'S CORKBOARD AND INSULATION SUNDRIES

a dripping faucet

_why not stop invisible electrical leaks?

Neglecting electrical circuits costs factory owners thousands in breakdowns . . . high power bills

YOU can *see* a faucet dripping. But an overloaded electric circuit may be wasting money in the form of heat losses without your ever knowing it. Only the treasurer, wondering why bills are so high, suspects that something must be wrong.

Heat losses are but one way in which dollars fly out the window needlessly when electrical circuits are neglected. Frequent breakdowns are another. Men and machines stand around idle. Or, voltage drops reduce machine output. Lumped together, the damages the industrial plant suffers from antiquated, deficient wiring are often enormous. And authorities estimate that *nine out of ten industrial plants today are being penalized because of obsolete electric wiring!*

Safeguard your plant

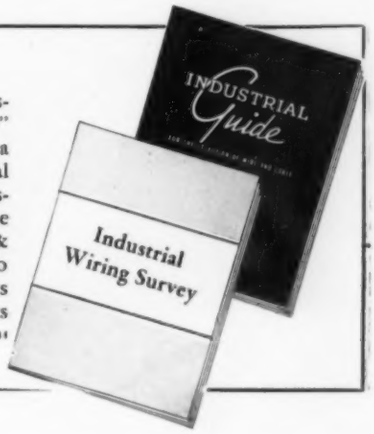
A wiring survey will cost you nothing and may save you thousands of dollars. We offer here a complete plan for such a survey. The books shown at right give you everything you need to initiate a check-up of your plant's circuits. New, informative, they are being used by hundreds of manufacturers. Send for them today.

If you have a specific problem in mind, consult our Engineering Department. We will cooperate without obligation. Why not take advantage of the many important improvements in cable design pioneered by Anaconda Wire & Cable Co.? Let us tell you about them.

Outstanding characteristics of this Anaconda cable are: 1. Its remarkable stability. This has been demonstrated by tests as well as by use in the field. 2. The compound is highly resistant to moisture, acids and alkalies. 3. Low susceptibility to combustion and explosion. 4. Its heat-resisting characteristics permit large emergency overloads.

Write for data on Duracode

FREE! The "Industrial Wiring Survey" tells how to make a check-up of electrical circuits. The "Industrial Guide for the Selection of Wire & Cable" tells how to correct conditions found. Both books will be sent free. 37841



Cable Company

Sales Offices in Principal Cities

ANACONDA
from mine to consumer

ENDURING SAFETY IN GLOBE STAINLESS AND SEAMLESS TUBES

OF COURSE you want tubing that is easy to keep thoroughly clean . . . tubing that is not itself affected and does not affect process products . . . and you get that kind of tubing in Globe Seamless Tubes, plus these advantages:

— no seams or welds, no niches, cracks or crevices which might harbor bacteria.

— no thin protective inside coating. No bare spots from scouring and sterilizing. Entire wall thickness is stainless steel. Daily scouring only increases the polish. Sanitation improves with age.

— no circular inside scratches. Any microscopic scratches, from polishing grit, run lengthwise. Flow of foods and cleaning compounds tend to keep them flushed out.

— 25 years of specialization in seamless tubing. A wealth of practical knowledge is back of every foot of Globe Stainless Tubing.

GLOBE Seamless TUBES

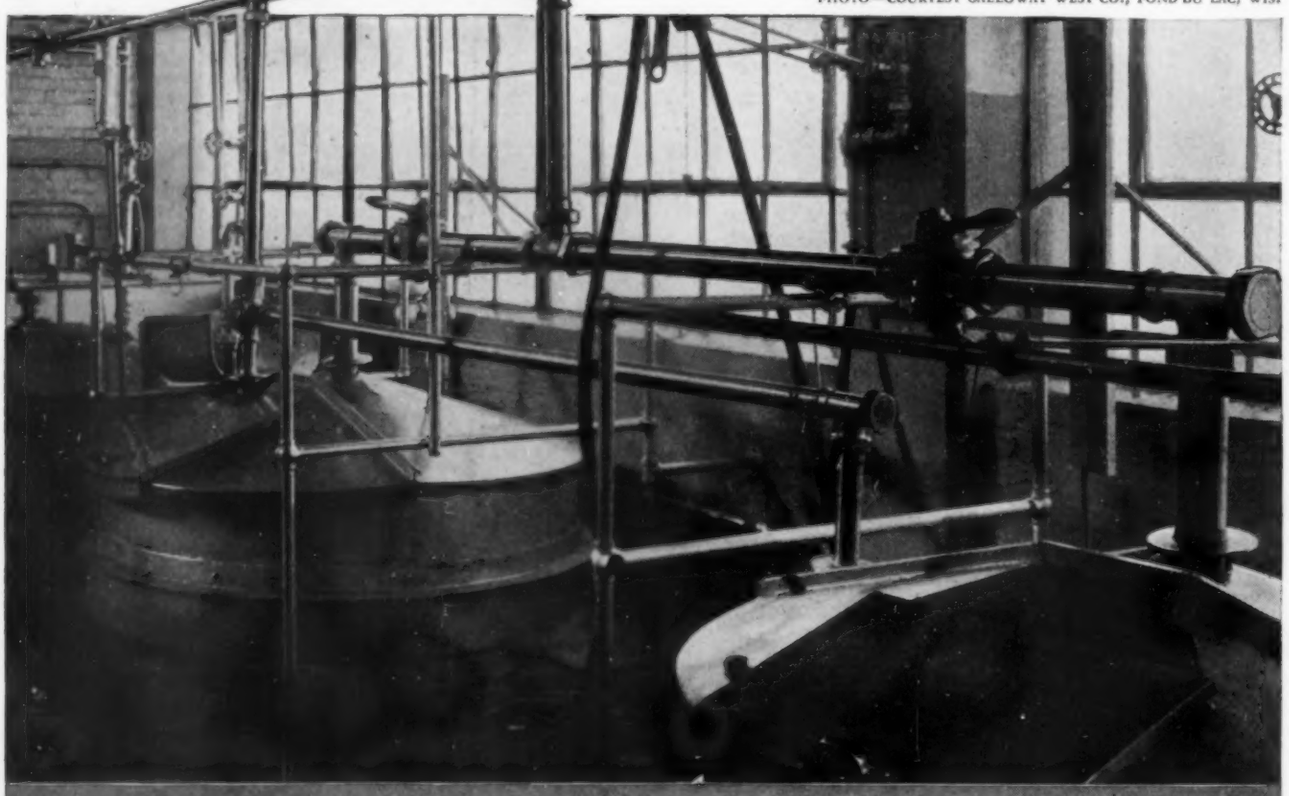
You can have the reliability, long life, economy and sanitation of Globe Stainless Tubes in 18-8 and in other analyses.

A Globe engineer will gladly give you detailed technical information and cooperate with you in making any necessary service tests. Write us about your problems.

GLOBE STAINLESS TUBE CO.
4006 W. BURNHAM ST. MILWAUKEE, WIS.

Globe sanitary Stainless Steel Tubing leading to and from and connecting forewarmers previous to condensing in a milk processing plant.

PHOTO—COURTESY GALLOWAY WEST CO., FOND DU LAC, WIS.



GLOBE STAINLESS TUBES
Stainless for Sanitation

A Complete Line for Specific Pressure Conditions

The *Why* of Wider Seat Faces!

"NS5" Alloy Plug Type Seat and Disc

The greater area of the full plug width seating surface combined with the fine wearing properties of "NS5" Alloy retards wire drawing and promotes longer service life.

"NS5" Alloy seating material is of uniformly great hardness and retains its hardness at high temperatures; it will not gall or seize, and is highly resistant to corrosion.

An added economy feature is the interchangeability of seats and discs, whereby users of Lunkenheimer regular "Ferrenewo" and "Renewo" Valves, can convert them into plug type by simply changing the seats and discs.

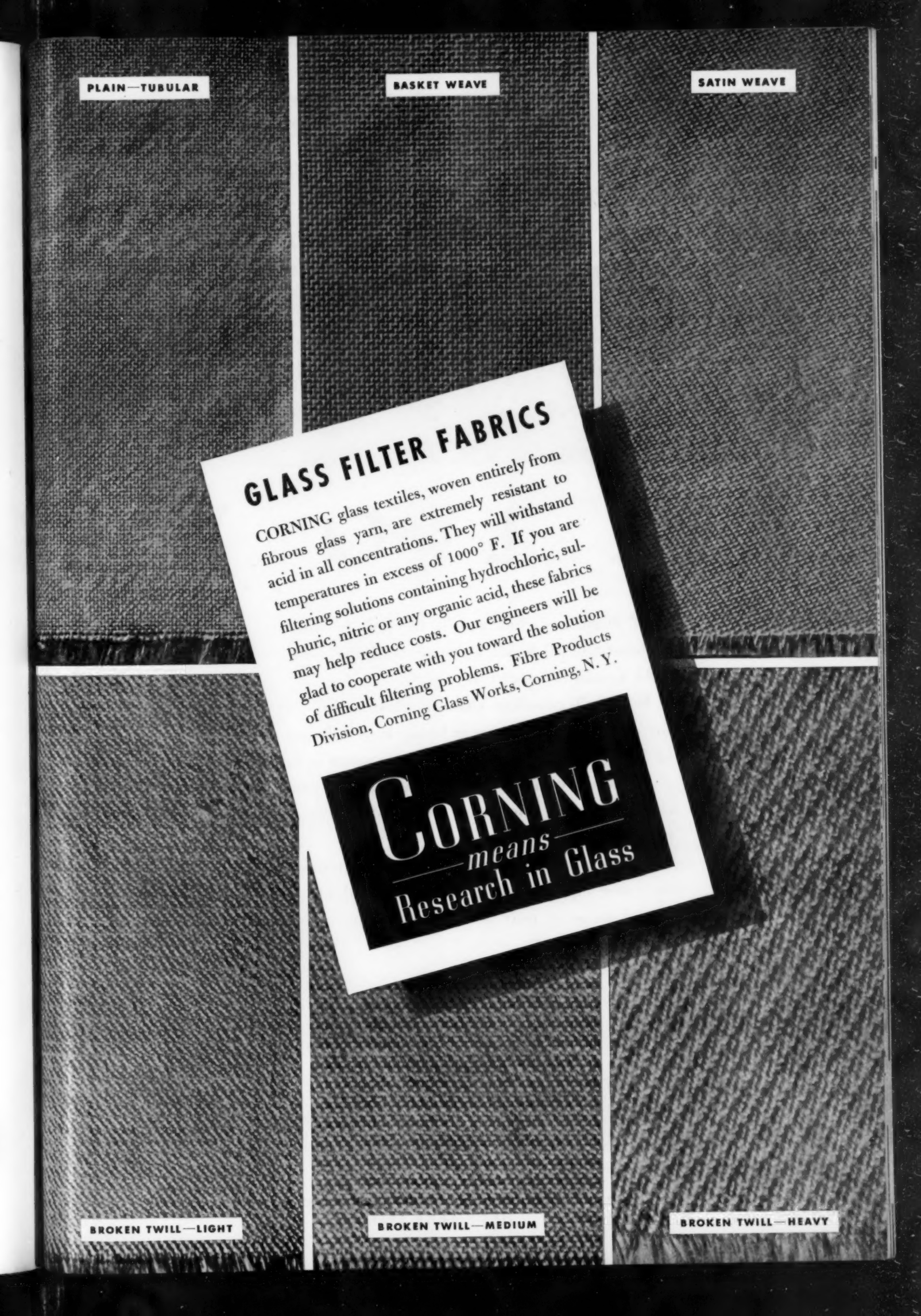
Place a few of these valves in service in your plant and let them prove themselves under actual operating conditions.

Your Lunkenheimer distributor carries them in stock. Ask him for the new circular No. 559 or write us direct.

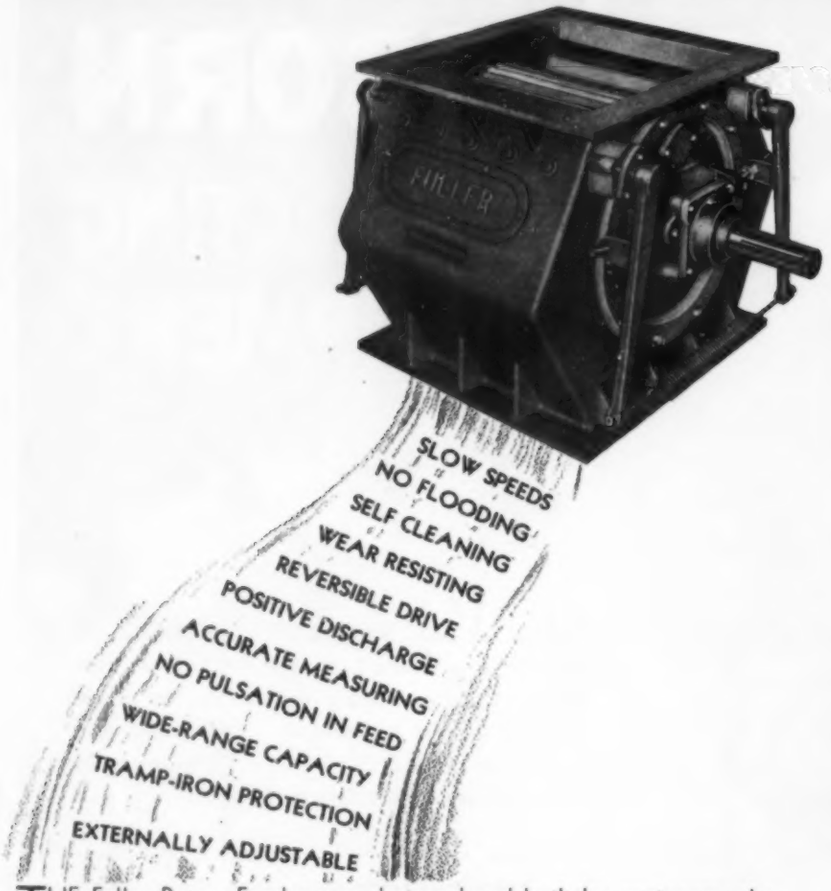
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

Buy QUALITY—Buy LUNKENHEIMER

102-88B-7


PLAIN—TUBULAR
BASKET WEAVE
SATIN WEAVE
GLASS FILTER FABRICS
CORNING glass textiles, woven entirely from fibrous glass yarn, are extremely resistant to acid in all concentrations. They will withstand temperatures in excess of 1000° F. If you are filtering solutions containing hydrochloric, sulphuric, nitric or any organic acid, these fabrics may help reduce costs. Our engineers will be glad to cooperate with you toward the solution of difficult filtering problems. Fibre Products Division, Corning Glass Works, Corning, N. Y.
CORNING
means
Research in Glass
BROKEN TWILL—LIGHT
BROKEN TWILL—MEDIUM
BROKEN TWILL—HEAVY

FULLER ROTARY FEEDERS



THE Fuller Rotary Feeder was designed and built by engineers who have been in close touch with the chemical fields for over twenty five years. They knew the problems involved, the difficulties encountered, and consequently, just what was required to do the job efficiently. Experiments were made under actual operating conditions for months until this feeder proved its worth. Then, and only then, was the Fuller Rotary Feeder placed on the market.

Now, after many installations have been made and operations proved successful, we recommend your consideration of this equipment for delivery of fine, crushed, granular, or pulverized materials. Our engineering department is at your service and will be glad to make recommendations for any problem you may have. Of course, there's no obligation on your part whatsoever.

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago: 1118 Marquette Bldg.
San Francisco: 320-321 Chancery Bldg.

A PARTIAL LIST OF USERS

Allentown Portland Cement Co.
Alpha Portland Cement Co.
American Machine & Foundry Co.
Ash Grove Lime & Cement Co.
Canadian Gypsum Co.
Colgate-Palmolive-Peet Co.
Coplay Cement Mfg. Co.
Dewey Portland Cement Co.
Edison Cement Corp.
Erie City Iron Works
Huron Portland Cement Co.
Lone Star Cement Co.
Marquette Cement Mfg. Co.
Mathieson Alkali Co.
Medusa Portland Cement Co.
Michigan Alkali Co.
Missouri Portland Cement Co.
Northwestern Portland Cement Co.
Petoskey Portland Cement Co.
Riverside Cement Co.
Southern Mineral Prod. Co.
Valley Forge Cement Co.

FULLER-KINYON, FLUXO, AND AIRVEYOR CONVEYING SYSTEMS · · · · ROTARY FEEDERS AND DISCHARGE GATES
ROTARY AIR COMPRESSORS AND VACUUM PUMPS · · · AUTOMATIC BATCH WEIGHERS · · · BIN SIGNALS

F-4

TELLTALE *Fingerprints*

● Unmistakably identifying the individual, fingerprints leave a record of their owner. Such records are being imprinted daily by busy fingers as they turn the pages of thousands of Crane catalogs.

In industrial plants everywhere—in purchasing departments—in engineering departments—in design, operation and maintenance of piping systems of all types, the Crane No. 52 Catalog is known as the dependable source book of buying, specifying and designing information.

Fingerprints on a Crane catalog identify not only the present leaders of American industry but that great army of workers of today who will be the big men of tomorrow. Turn to the pages of the Crane catalog whenever piping problems arise. Crane-Equip your plant for satisfaction.

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO, ILLINOIS

Branches and Sales Offices in One Hundred and Sixty Cities

VALVES, FITTINGS, FABRICATED PIPE, PUMPS, PLUMBING AND HEATING MATERIAL

plied in the next few days.

TRIPLE LIFE REVEALED BY FINGERPRINTS

COLUMBUS, OHIO, Nov. 17—That a Crane No. 52 Catalog leads a triple life in the chemical industries was revealed here today. Fingerprints on Crane catalogs show that they are often and widely used as a source of information on valves for service lines (steam, oil, gas and water), and also for valves and fittings to handle the varied corrosion problems in process lines.

In addition, a large proportion of the pages devoted to engineering data and tables show indications of considerable usage. This is as it should be, for the Crane No. 52 Catalog was compiled to be the largest single source of information about piping problems and piping equipment in the world.

How well it hits the mark is known by everyone who consults it. In fact, among the 38,000 items listed in its pages will be found the solution to practically every valve and fitting problem that confronts you. Use it for purchasing the valves and fittings you need for satisfactory piping installations.

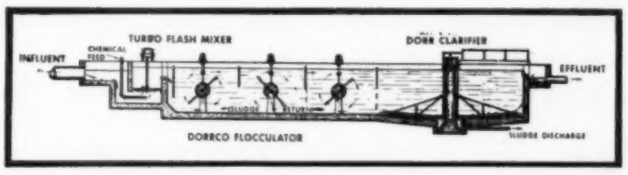
• CLEAN WATER •

FOR CHEMICAL PROCESSING

CLEAN process water, close to the plant site, once was a major consideration in plant location. Today, chemical manufacturers can locate at strategic points, confident that contaminated local water sources may be converted to sparkling clear processing water by modern mechanical and chemical methods.

The Dorr Water Purification System, in use at 100 or more cities for domestic water purification, is directly applicable to the water supply problems of the chemical industry. Flash Mixing with suitable chemicals, followed by Flocculation and Sedimentation, will definitely remove suspended silt and coloring matter—alone or in combination.

A Dorr engineer will gladly make a study at the site of your local water supply. He will bring with him a field test kit to demonstrate the kind of water you can expect from a Dorr System. Chemical costs generally range from $2.00 to $3.00 per million gallons—cheaper, by far, than sinking wells or buying water.



TOP—In the foreground, Dorrco Flash Mixers; directly behind, two Dorrco Flocculators; in the background, two Dorr Clarifiers.

ABOVE—A Dorr Water Purification System.

DORRCO

• WASTE TREATMENT •

The Dorr organization also possesses a broad background of knowledge and experience in the treatment of industrial wastes. Dorr waste treatment plants are successfully preventing stream pollution in several dozen different industries.

If you have such a problem it may pay you to consult us.

THE DORR COMPANY INC.

ENGINEERS • 570 Lexington Ave., New York

ATLANTA • TORONTO • CHICAGO • DENVER • LOS ANGELES

DORR TECHNICAL SERVICES AND EQUIPMENT ARE ALSO AVAILABLE FROM THE FOLLOWING COMPANIES:

NETHERLANDS: Dorr-Oliver N.V., The Hague • ENGLAND: Dorr-Oliver Company Ltd., London • GERMANY: Dorr Gesellschaft, m.b.H. Berlin • FRANCE: Soc. Dorr-Oliver, Paris
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THE ENGINEER FROM INSULATION HEADQUARTERS SAYS:

"LIKE ALL STOCKS— ALL INSULATIONS DON'T PAY THE SAME DIVIDENDS!"

"SINCE insulations are purchased as an investment, the matter of dividends is of prime importance in their selection.

"As in the case of stocks, these insulation dividends are bound to vary. In fact, the cash returns in fuel savings promised by any given insulation are dependent upon three things . . . *kind, amount and application.*"

This statement—by the man from Insulation Headquarters—deserves the attention of every insulation buyer interested in securing the greatest return on his investment.

It is based on experience gained by Johns-Manville through some 75 years of research and practical field service. Experience which has shown that one . . . five . . . or ten different kinds of insulations cannot possibly meet with maximum efficiency and economy the requirements of *all* heated or refrigerated equipment on the market today.

This is a truth long recognized at Johns-Manville. The present line of J-M Insulations totals some *forty* different types . . . each designed for a specific insulating service . . . And all sharing in common a time-established record for superior performance and durability.

Hence, having a line of insulations so unusually complete, Johns-Manville is in a position to help you choose the type and thickness of insulation that will assure maximum cash dividends, over the longest period of time, on each insulating job in your plant.

For full details on all J-M Insulating Materials, ask for Catalog GI-6A. Johns-Manville, 22 E. 40th St., N.Y.C.

JM PRODUCT

Johns-Manville INDUSTRIAL INSULATIONS

An insulating material for every temperature . . . for every service condition

Have you heard about BARTLETT-SNOW'S K-1134?

● File No. K-1134 was started when a far-distant company wrote "—what can you do about this problem?" From that point on things happened.

Samples of the material were sent for—received—and subjected to exhaustive tests. All factors including those of corrosion, dust, galvanic action and sensitivity to heat were carefully studied—checked—re-checked.

A Bartlett-Snow special Style D Dryer, fabricated in part of stainless clad, in part of solid stainless, was recommended, purchased, shipped. Since then, and within a period of fourteen months, a duplicate of the first was purchased—then two more—then two more of slightly larger size, making six in all.

It's luck you say that enables these Bartlett-Snow Indirect Heat Dryers to minimize the dust problem, reduce the moisture content of small carbon particles from 50% to less than 1%, and overcome the galvanic action, so that the desired capacity is secured without damage to the product or the equipment? Not at all. Its technical approach, the use of formulas developed—and used only—by Bartlett-Snow heat engineers—the plus value—your assurance that the equipment recommended by these experts will be suited exactly to the problems to be met. What are your heat engineering problems?

THE C. O. BARTLETT & SNOW CO.
6204 Harvard Avenue **Cleveland, Ohio**

In Chicago:
First National Bank Building

In New York:
30 Church Street

BARTLETT-SNOW *Rotary Dryers*

COOLERS • CALCINERS • ROTARY KILNS • ROASTERS

"PACKAGED"

Temperature Regulation..

ave you ever stopped to think
at you can buy all the accu-
ate, dependable temperature
egulation you need for many
rocessing jobs in your plant...

–for a relatively few dollars

–packed in a box ready for
instant service, complete with
all the power that will ever
be needed for faultless oper-
ation day in and day out

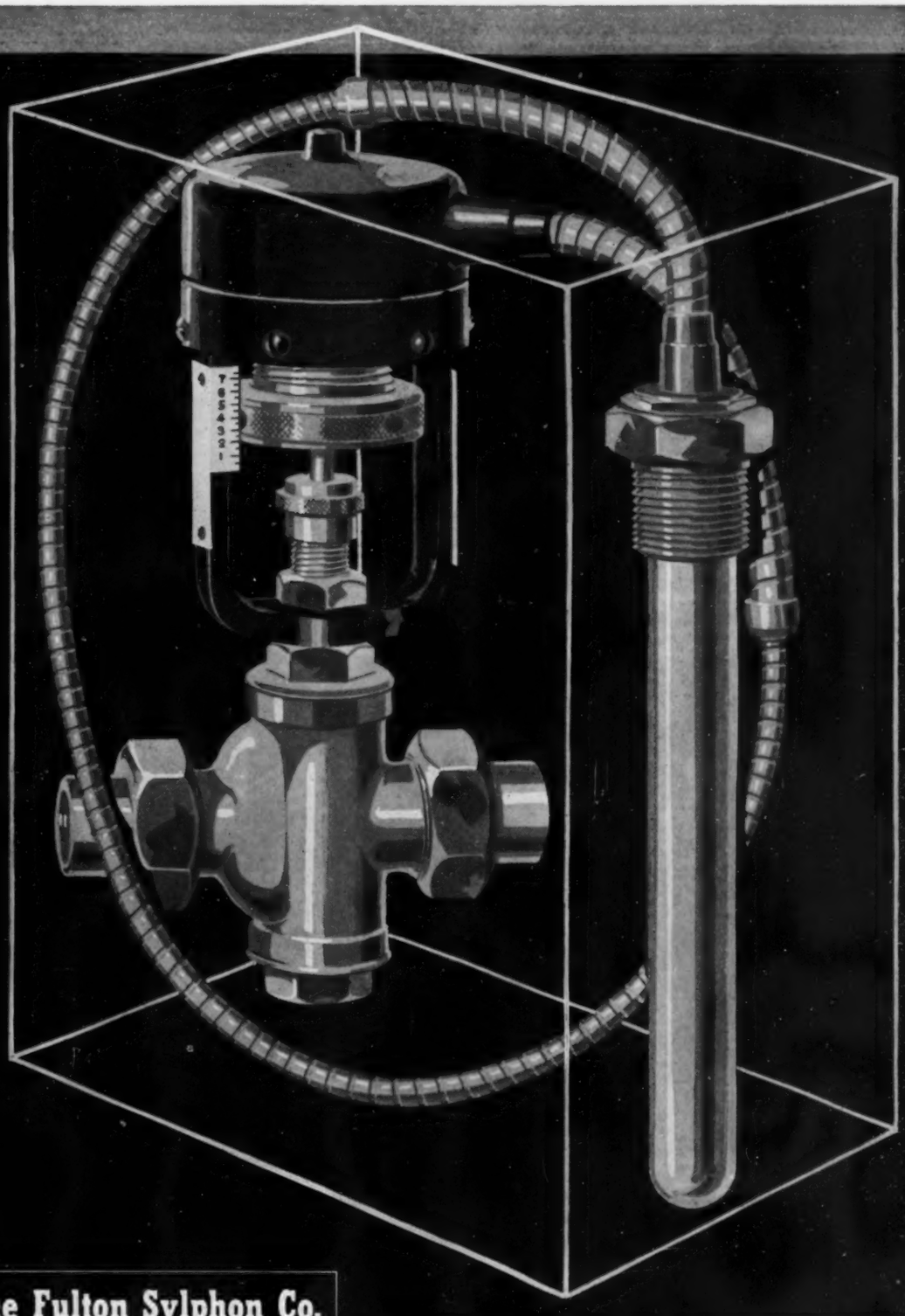
–requiring no auxiliary equip-
ment, wiring, motors, switches,
relays, air compressors or high
pressure piping—no expen-
sive engineering counsel, no
complicated "systems"

–that can be easily and quickly
installed by any steamfitter!

nvestigate Sylphon Control.
These self-contained, self-pow-
ered, self-sufficient control units
re regulating refrigeration and
eat processing temperatures
rom 40° below zero to 350° F.
bove in more than 250,000 in-
tallations. They are offered by
he pioneers and world leaders
n self-contained temperature
ontrol instruments, with over 35
ears' experience in industrial
ontrol problems.

Ask for a nearby Sylphon
epresentative to call—or write
or Bulletin X B 20.

Illustrated at right: No. 921 Sylphon Temperature Regulator. A compact, accurate, rugged, dependable unit for application on many kinds of equipment where space is at a premium—cost is a factor and simplicity is highly desirable.



The Fulton Sylphon Co.
KNOXVILLE, TENNESSEE
Representatives in All Principal Cities in U. S. A. and in Montreal, Canada and London, England

SYLPHON Control

"POWERED BY THE TEMPERATURE IT REGULATES"

After 9 Years Service

The J. Pabst Sons Co.

DR. PEPPER ORANGE-CRUSH — 611 CENTRAL AVENUE — HAMILTON, OHIO — PABST IMPERIAL MALTS

August 31, 1937

A.W. Cash Company
Decatur, Ill.

Gentlemen:

We have just followed the suggestion made in your letter of the 20th. To our surprise we found that the strainer screen was clogged up even more than shown in the cut in your bulletin.

It was easily cleaned and put back together, and now the regulator works perfectly again.

After nine years operation, to our way of thinking, this speaks very well for your product.

Thanking you for your help, we are

Yours very truly

WJP.P — THE J. PABST SONS CO.

All It Needed Was Cleaning!

The letter tells the story . . . and it's typical of the experience of Cash Standard valve users. After 9 years continuous use, this Class D valve simply needed cleaning.

Quickly and Easily Done

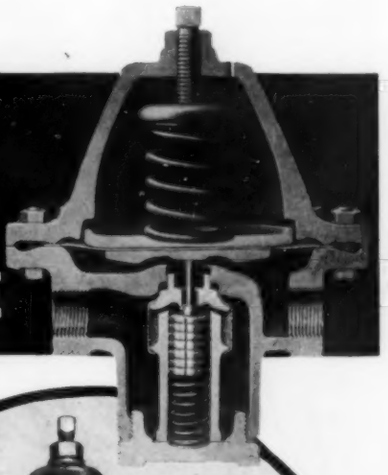
No removing the valve or dismantling it. No readjustment or testing. The working unit was simply removed by one of the plant's own men, the screen cleaned, and then replaced.

Worked Perfectly Again

There's proof of durability, simplicity, and low maintenance cost! Cash Standard Class D Pressure Reducing Valve avoids binding and sticking. Simplicity, strength and trouble-free service are apparent from this cut-out view.

CASH STANDARD

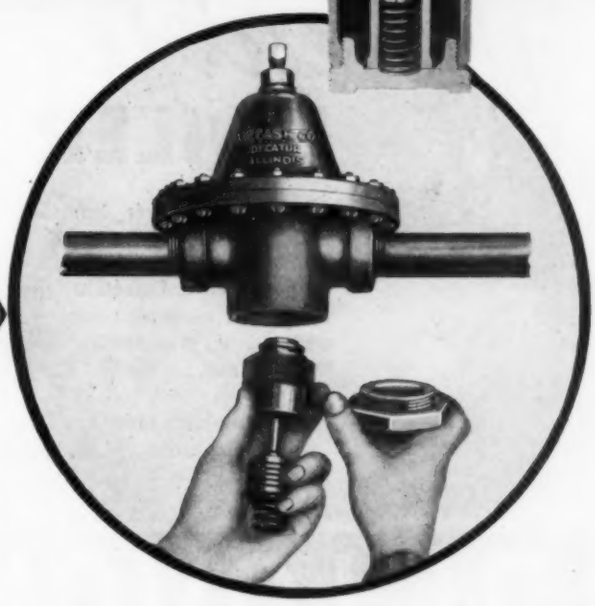
CLASS D PRESSURE REDUCING VALVE



A Cure for "IDLE MEN"

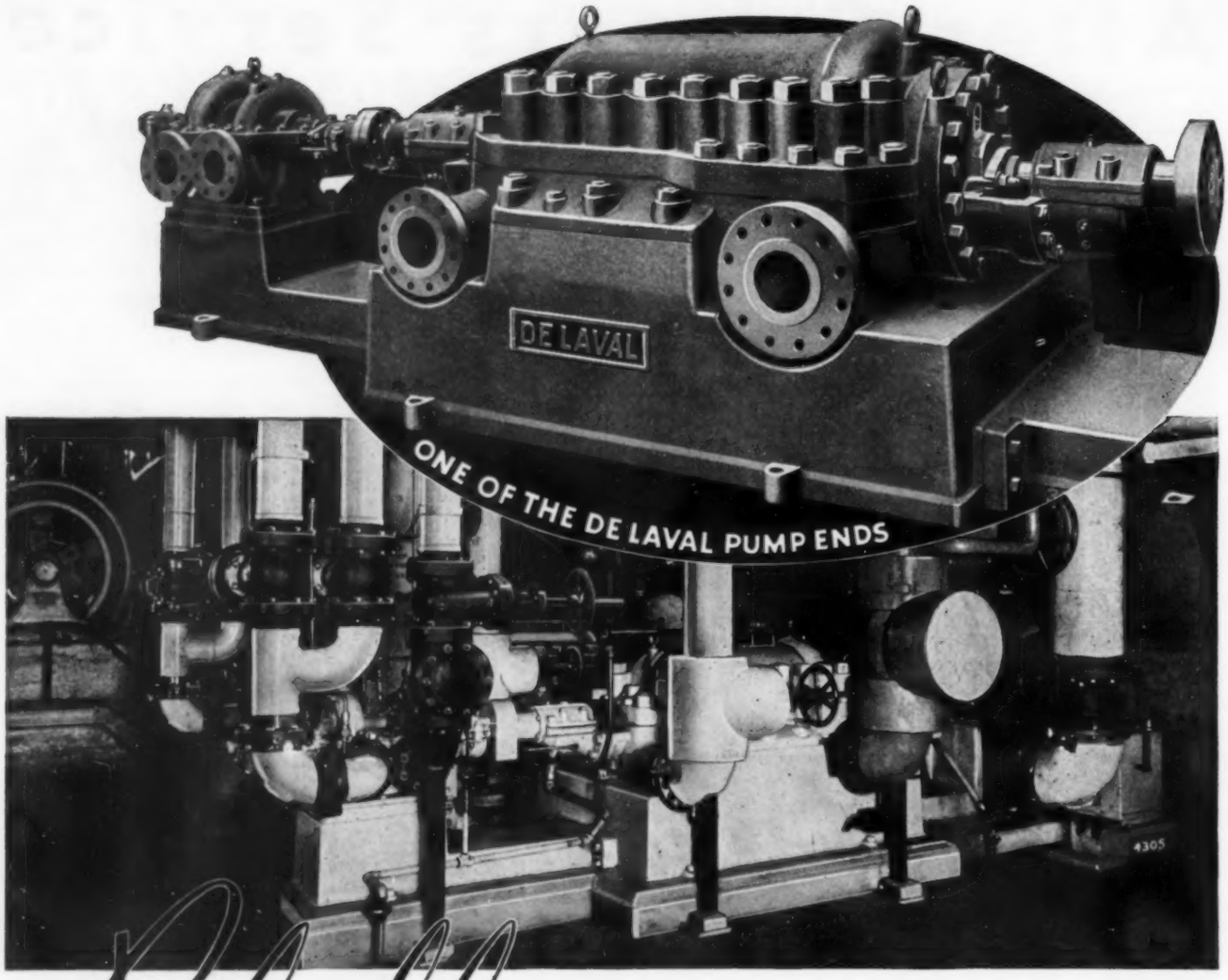
Long delays—production at a standstill while valves are removed, repaired, and replaced—or sent back to the manufacturer for repair . . . you avoid all this with the installation of the Cash Standard Class D Valve with

CARTRIDGE TYPE WORKING UNIT



Unscrew the bottom closing cap, remove the complete assembly . . . cylinder, piston and all. Replace it as simply. Any man can do it—saving hours of time when time counts. By replacing with an inexpensive renewal unit, if necessary, the valve is good as new. There's a lot more to say about this Class D valve. Write and we'll send the complete bulletin.

A. W. CASH COMPANY, DECATUR, ILLINOIS



Turbine driven boiler feed unit in foreground and motor driven unit in rear.

Reliable BOILER FEED PUMPS

IN changing over from 225 lb. steam pressure to 710 lb. at 850° F. total temperature, the central station in which this photograph was taken installed these two *DE LAVAL combined boiler feed and hot well pumps,* one turbine driven and one motor driven, for the first 30,000 kw. turbine unit.

The variable speed A. C. motor permits varying the pressure differential between pump and boiler drum, which saves power, reduces maintenance on feed regulator and improves the regulation.

The turbine driven unit, also variable speed, receives steam at full pressure and temperature but is quick-starting without previous warming up, as required to meet emergencies.

Since installing these pumps, *EIGHT MORE DE LAVAL* high pressure boiler feed units have been added.

Ask for Leaflet C.

B601

DE LAVAL *Steam Turbine Co.*
TRENTON, N. J.

MANUFACTURERS OF STEAM TURBINES, PUMPS—CENTRIFUGAL, PROPELLER, ROTARY DISPLACEMENT, CENTRIFUGAL BLOWERS AND COMPRESSORS; WORM GEARS; HELICAL GEARS; HYDRAULIC TURBINES AND FLEXIBLE COUPLINGS • • • SOLE LICENSEE OF THE BAUER-WACH EXHAUST TURBINE SYSTEM

MORE REASONS

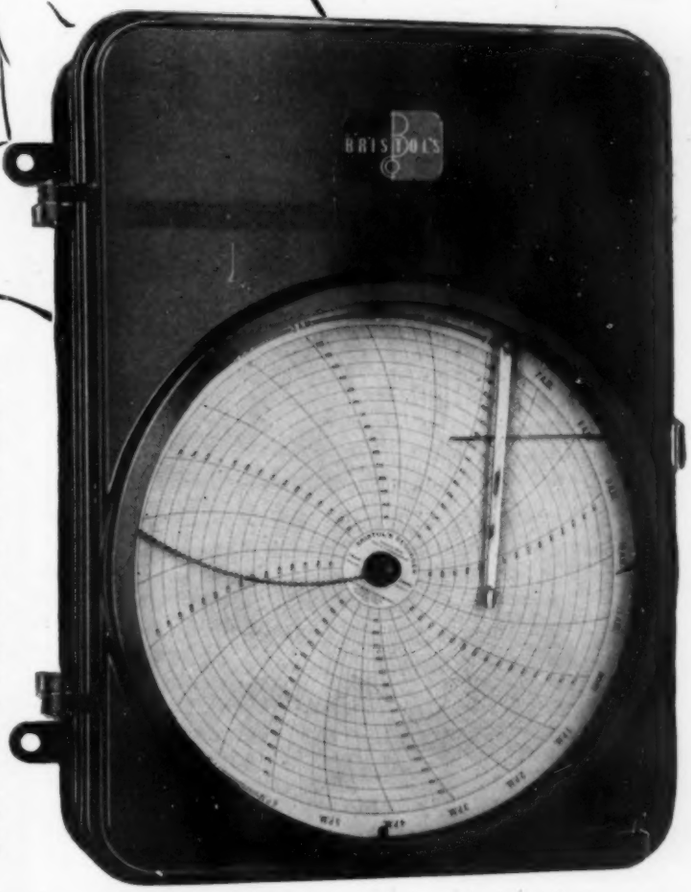
why you'll like this new electric thermometer

MODEST in first cost... maintenance lower

ACCURACY easier to check

EASIER to service—your own men can do this

NO ANNOYING DELAYS or time out should heat-sensitive elements be damaged



BRISTOL'S Recording Pyromaster Thermometer has been on the market only a few months. Yet in that short period it has won the enthusiastic endorsement of users everywhere. Features like its simplified mechanism, that operates only when readings are changing, that needs no lubrication, that is unaffected by vibration, appeal to the practical engineer.

But that isn't all. Bristol's Pyromaster Thermometer is surprisingly free from costly and time-consuming servicing. Should the heat-sensitive element become accidently broken or damaged, it can be replaced quickly and inexpensively. There are no annoying delays. No time out. The same can be said about the simple wiring that connects the sensitive element to the instrument. Write for Bulletin No. 489C.

THE BRISTOL COMPANY, WATERBURY, CONN.

Branch Offices: Akron, Birmingham, Boston, Chicago, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle. Canada: The Bristol Company of Canada, Limited, Toronto, Ontario. England: Bristol's Instrument Company, Limited, London, N.W. 10.

BRISTOL'S PYROMASTER

Round Chart Direct Ink Marking Recording Thermometer

The 650-mile system of the Houston Pipe Line Company supplies natural gas to such varied Texas coastal industries as oil wells, oil refineries, heavy chemical plants, paper and textile mills, sulphur wells, salt mines, lime plants, etc.

SOBER FACT

This is sober fact: the industry which overlooks the Texas coast country as a location for plant expansion or decentralization is overlooking the industrialist's new Golconda. The Texas coast offers industry so many distinct advantages of location that few regions in the United States, or in the world, can compare with it. Consider these:

Markets

The State of Texas is an immediate market of 600,000 consumers of everyday items. Industrially, there is a tremendous and varied market in Texas' oil industry alone, and oil is by no means Texas' only industrial development. Railroads enable you to tap the Middle West at advantageous rates. Water links you to the teeming Atlantic seaboard, to all the Gulf ports, to the busy Pacific cities. Foreign markets—European, Oriental and Latin American—are easily reached from any of 10 Texas ports.

Transportation Facilities

The long Texas coastline boasts of a number of deep-water ports, any one of which is a suitable shipping point for practically any cargo. These ports are already established, and the volume of their tonnage is enormous; Houston, for example, is the second port in total tonnage in the United States. Through railways tie an industrial location on the Texas coast to all inland markets. An excellent highway system, with numerous common carrier truck lines, and extensive airline communications complete the transportation picture.

Resources

Industrial resources on the Texas coast are varied, and they are available in quantities which will support an extensive industrial development. These include petroleum, crude and refined (Texas is the largest oil producing state); petroleum by-products; lime; sulphur; salt; carbon black; clays (including fuller's earth); cattle; cotton; wool and mohair (Texas leads the nation in the production of all three); metallic and non-metallic ores; lumber; natural gas* and many others.

Climate

The climate on the Texas coast is mild and equable from year's end to year's end. This makes the region a pleasant place to live, enables executive and working man to play out-of-doors (hunting and fishing are democratic sports in Texas), lowers heating bills, tends to reduce factory operation costs.

Available Sites

Plant sites are still available at moderate cost in the coastal towns and cities of Texas. The people are enterprising and ambitious, they realize that their country has an industrial future; and these facts combine to enable the industrialist to find a site suited not only to his needs but also to his budget.

Fuel

For fuel there are inexhaustible supplies of natural gas, the most efficient and economical of industrial fuels. It is clean and easy to handle; it reduces furnace maintenance costs; its use eliminates the necessity of investing in expensive handling machinery and storage space; and its combustion is more easily controlled by automatic control devices. The availability of natural gas in unlimited quantities has been, is, and will be a decisive factor in the location of new industry on the Texas coast.

Send for a Survey

. . . of this industrial Land of Canaan. Without cost or obligation, our research department will gladly prepare for you a technical report on the Texas coast country, **individualized to your company's needs.** You will find it an engineer's report, comprehensive, accurate, reliable . . . Your request will be kept in strictest confidence. Address Houston Pipe Line Company Petroleum Building, Houston, Texas.

HOUSTON PIPE LINE CO.
Subsidiary of Houston Oil Company of Texas
CEO. A. HILL, JR., President
Wholesalers of
Natural GAS

*The use of natural gas as a raw material for the chemical industry is already engaging the interest of the research chemist. Possibilities which have already been explored open new vistas to the industrialist.

Guard LIFE and PROPERTY...

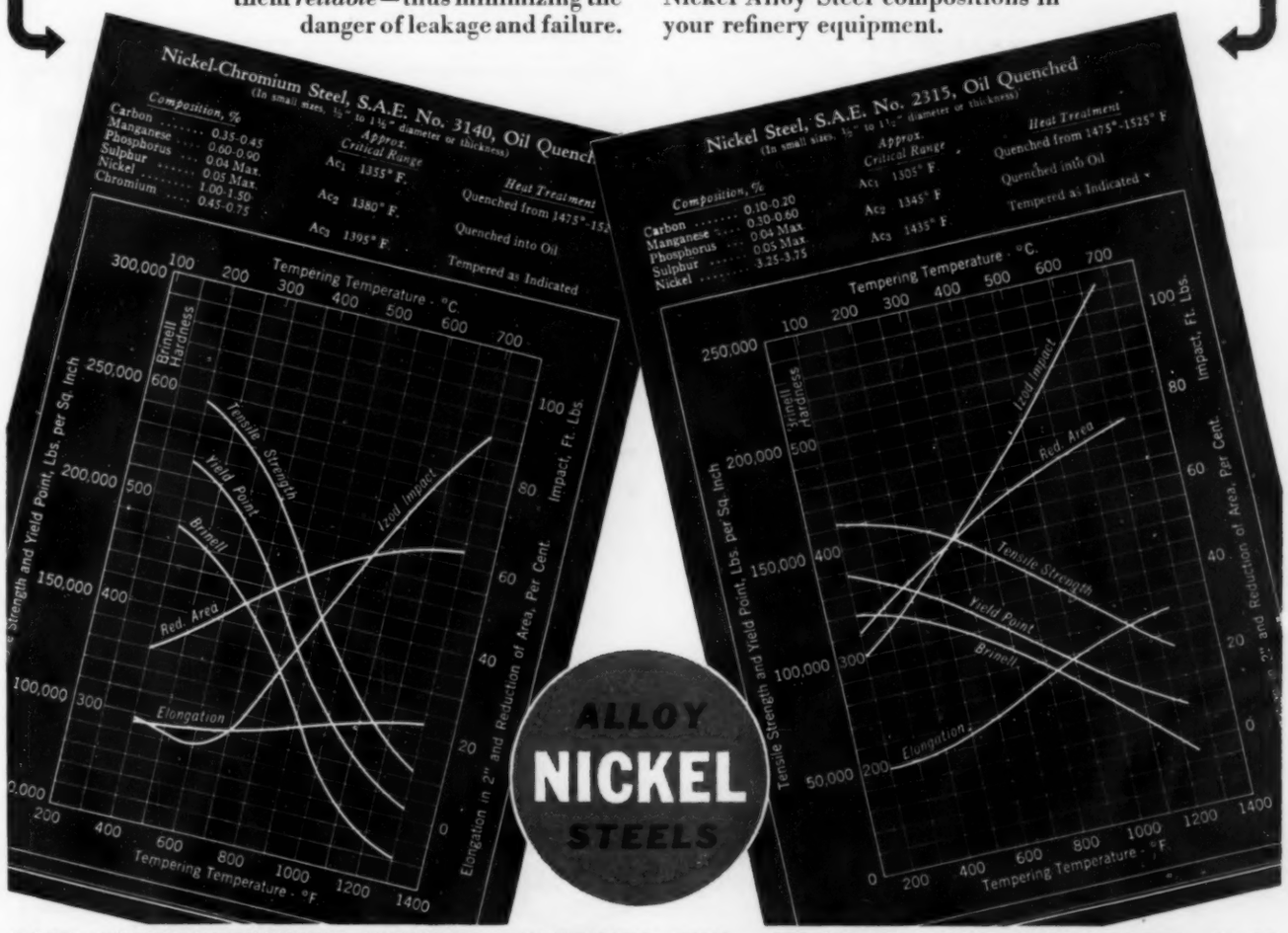
... with these strong—tough stress-resisting refinery bolts

FOR HIGH TEMPERATURE SERVICE

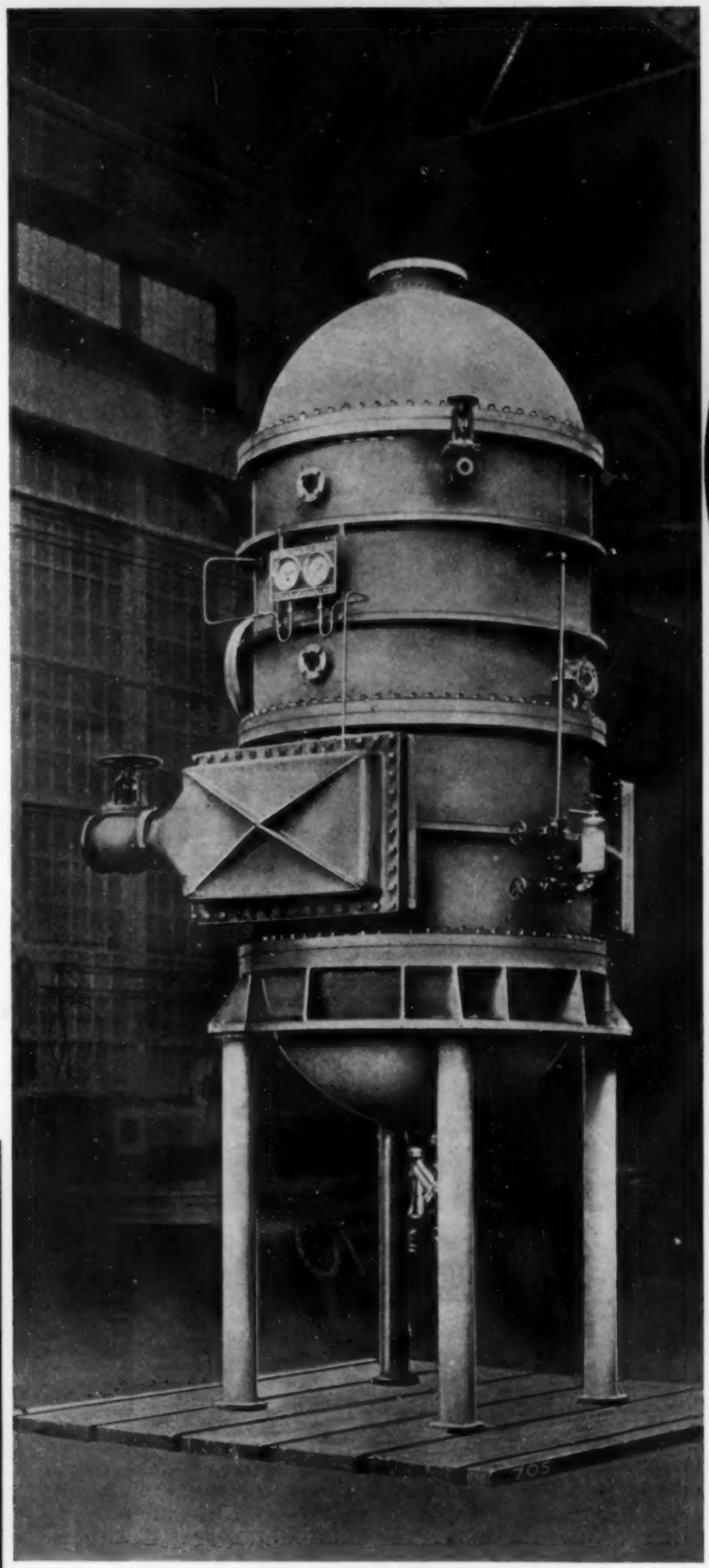
When refinery lines are running at 900° F. to 1200° F. leakage or failure of a pipe joint may be the forerunner of disaster. Hence, refinery bolts must be made of dependable materials—capable of withstanding the mechanical stresses of tightening up as well as the additional thermal and pressure stresses encountered when the lines are running hot in operation. Nickel Alloy Steels are used for this vital application because their high yield strengths and toughness make them *reliable*—thus minimizing the danger of leakage and failure.

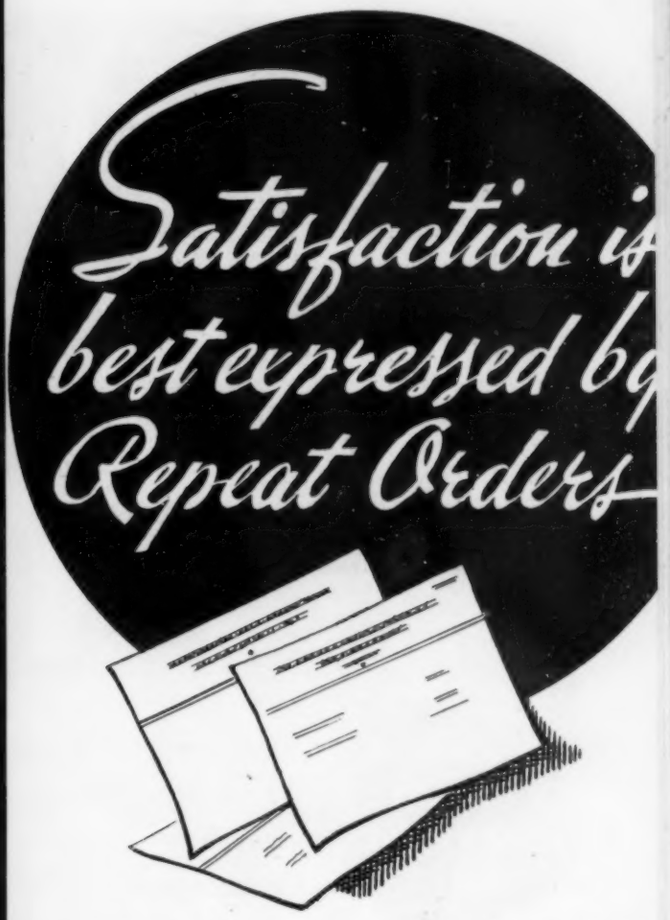
FOR LOW TEMPERATURE SERVICE

The use of subzero temperatures in refining operations requires materials which stay tough in extremely cold zones. Bolts of Nickel Alloy Steel resist low temperature embrittlement and provide the requisite physical properties. • • The accompanying charts give the mechanical properties of two Nickel Alloy Steel compositions which are especially suitable for refinery bolts, used in high and low temperature service. We invite consultation on the use of these and other Nickel Alloy Steel compositions in your refinery equipment.



THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.





Used in the concentration of a product that contains free sulphuric acid, this Struthers-Wells All-Cast Lead Evaporator was built several years ago for a large chemical company. Today we are duplicating this installation for the same company which shows that this piece of equipment has operated entirely to the customer's satisfaction.

Cast in our own foundries, it is equipped with seamless copper, lead-covered horizontal tubes. The tube plates are of steel plate with a perfectly bonded lead coating on the inside to resist acid corrosion.

It is a typical example of the many types of Struthers-Wells equipment available for the process industries.

STRUTHERS-WELLS EVAPORATORS

INCLINED, VERTICAL TUBE, HORIZONTAL

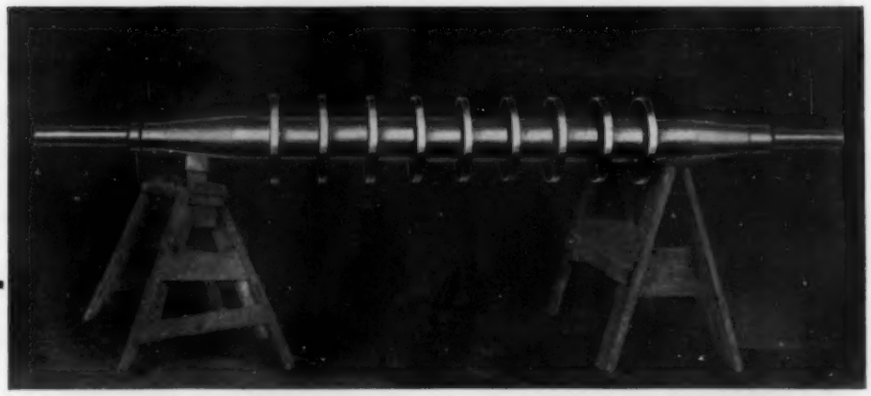
FORCED CIRCULATION

STRUTHERS-WELLS

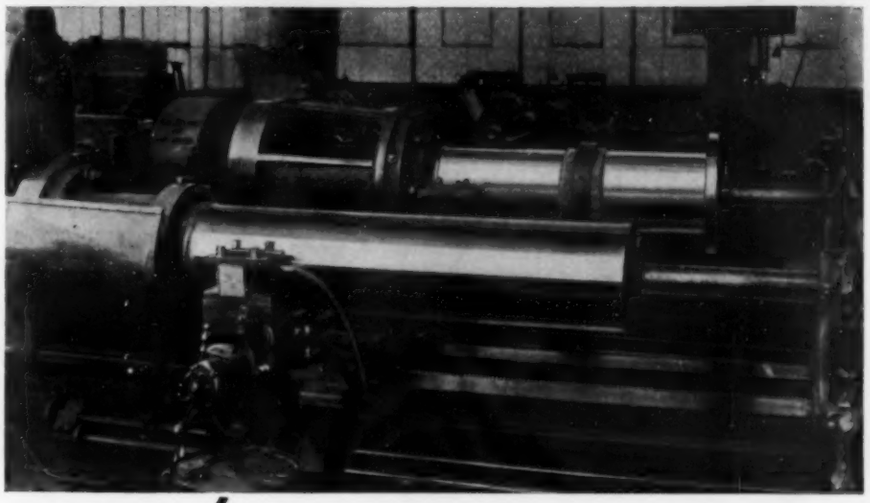
DIVISION OF STRUTHERS-WELLS-TITUSVILLE CORPORATION

TITUSVILLE, PENNA.

PLANTS AT WARREN, PENNSYLVANIA AND TITUSVILLE, PENNSYLVANIA, ALSO
TITUSVILLE IRON WORKS COMPANY · TITUSVILLE FORGE COMPANY



Every Modern Facility...



For Pouring and Finishing CENTRIFUGAL CASTINGS

Buyers of tubular products should consider carefully these three points:

1—centrifugal castings are superior to other forms of castings. The metal is denser and free from blow-holes and gas pockets. Diameters are very true and concentric.

2—centrifugal castings permit wider variations in Cr, Ni and Fe content than other tubular forms, thus making even more useful the properties of high alloys for resisting heat, corrosion and abrasion.

3—Duraloy has all the facilities necessary for turning out sound centrifugal castings and for finishing them. And what is more important—the experience! The Duraloy Company was among the first to make these superior castings.

Why not make Duraloy your source of supply for Centrifugally Cast tubular products?

THE DURALOY COMPANY

General Office and Plant: SCOTTDALE, PA.

New York **Pittsburgh** **Cleveland**

Equipment Materials and Supplies for the Process Industries

CHEMICAL & METALLURGICAL ENGINEERING

SERVICE SECTION

Equipment Materials and Supplies for the Process Industries

Clark 2-Ton Telescopic "Tructier" Finger Tilt—Hydraulic Brakes—Front Wheel Drive—Rear Wheel Steer.

CLARK
Industrial Trucks and Tractors

Over 50 models—all gas-powered for continuous operation. Tell us what you want to lift, carry, tier or tow and let us suggest equipment for doing the job economically.

CLARK TRUCTRACTOR
Div. of Clark Equipment Co.
BATTLE CREEK, MICHIGAN

Direct Gas Powered
—always. Since 1917

LaMOTTE CHEMICAL CONTROL SERVICE

LaMotte Universal pH Outfit

This compact LaMotte Outfit is readily portable, yet it covers a wide pH range. Can be supplied with any 3, 4, 5, 6 or 7 sets of LaMotte Permanent Color Standards and will therefore cover any desired part of pH range, 0.2-13.6. Applicable to all types of research and industrial pH work. Accurate to 0.1 pH. Excellent for use with highly colored or turbid solutions.

Price $35.00 to $55.00 f. o. b. Baltimore, Md.

LaMOTTE
CHEMICAL PRODUCTS CO.
Originators of Practical Application of pH Control
444 Light St. Baltimore, Md.

ALL PURPOSE AIR VELOCITY METER

INSTANTANEOUS DIRECT READING

With the Alnor Velometer you can obtain accurate, instantaneous, direct readings of the velocities of irregular shaped or slotted grilles, in ducts, obtain static, or total pressures all without timing or mathematical calculations.

You can locate leak or losses, detect drafts, determine efficiency of fans, filters, blowers, or faulty duct construction. Ranges 20 F.P.M. to 6000 F.P.M.

Write for folder

ILLINOIS TESTING LABORATORIES Inc.
345 Hubbard St. Chicago, Ill.

"HURRICANE"
DRYING
and
Conditioning Machinery
Tunnel Truck and Conveyor Dryers, Stove Rooms, Ovens and Furnaces
35 Years Experience
THE PHILADELPHIA DRYING MACHINERY CO.
3351 STOKLEY ST. PHILADELPHIA, PA.

ELECTRIC VALVES

Automatically Controlled by THERMOSTAT TIME SWITCH OR FLOAT SWITCH AC or DC

Can be applied to air, water, gas, liquid, oil, etc.

Thousands in use, minimum servicing.

Write for full Data.

ELECTRIC VALVE MFG. CO., Inc.
66 Murray St. New York, N.Y.

WYCKOFF REDWOOD PIPE

Clear California Redwood pipe has greater carrying capacity than metal or concrete pipe. Does not clog, scale or pit. Light weight. Easily installed. Not affected by electrolysis, worms, frost and resists heat. Use it for sewage, liquors, acids, water, heavy fluids containing grit — for flumes, fume ducts, etc. Sizes 1" and up. Pressures at 172 lbs. We also manufacture Redwood Underground Steam Pipe Castings. Lengths up to 12 ft.

A. WYCKOFF & SON CO.
OFFICE & FACTORY—12 HOME ST., ELMIRA, N.Y.
Originators of Machine Made Wood Pipe
1855—*Our Eighty-Second Anniversary*—1937

THE Service Section of Chemical and Metallurgical Engineering supplements other advertising in this issue with these additional announcements of products and services essential to modern plant operation. Make a habit of checking this page each issue.

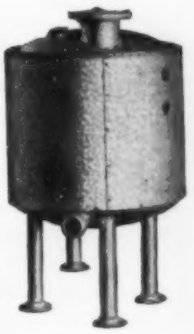
COPY FOR NEW ADVERTISEMENTS FOR THE JANUARY ISSUE OF CHEM. & MET. MUST BE RECEIVED NOT LATER THAN JANUARY 7TH.

Are These Orders Or Complaints

If they are orders, your equipment will have to be in perfect condition to turn them out both quickly and economically. If they are complaints, regarding either delivery or quality, something must be done about your equipment.

KOVENIZED equipment, in all the leading non - corrosive, commercial metals, has increased production and cut costs in many of America's foremost factories. The KOVEN Engineering Staff would be pleased to advise you, without obligation, concerning your equipment problems.

Some of the many KOVEN products are: pressure vessels, extractors, mixers, stills, condensers, kettles, tanks, chutes, bins, containers, stacks, piping coils.



A KOVEN Steel Still for the dry cleaning industry

L. O. KOVEN & BRO., INC.

154 OGDEN AVE., JERSEY CITY, N. J.

A KOVEN Stripping Machine

LARGE OR SMALL - IF KOVEN MADE - IT'S WELL MADE

PROFESSIONAL SERVICES

PATENTS
REPORTS
TESTING

PLANT DESIGN
INVESTIGATIONS
GENERAL CONSULTING

RESEARCH
PROCESSES
MANAGEMENT

CHEMICAL, BACTERIOLOGICAL AND NUTRITIONAL ANALYSIS

INDUSTRIAL PROPERTY NEAR PHILADELPHIA, PA.

FOR SALE AT A SMALL FRACTION OF COST

70 Acres—1000 Feet Frontage on Delaware River. Deep Channel Accommodating Large Merchant Vessels, Fresh Water with Infinitesimal Salt Content

THE PROPERTY IS ADJACENT TO CONCRETE TRUNK HIGHWAYS AND HAS FOUR PRIVATE SIDINGS FROM THE PENNSYLVANIA RAILROAD

Two Buildings with 153,000 Sq. Ft. Floor Space—Electric, Gas, Compressed Air, Steam and Signal Lines in Underground Conduits Throughout the Property

LOW TAXES—GOOD LIVING CONDITIONS—EXCELLENT LABOR MARKET

FOR PARTICULARS, PLANS AND PHOTOGRAPHS, WRITE TO

TRAYLOR ENGINEERING & MANUFACTURING COMPANY

ALLENTOWN, PENNSYLVANIA

POSITION VACANT

SALES ENGINEER with experience in pump applications in chemical process and food industries desired by established equipment manufacturer specializing in related field. P-664, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

EMPLOYMENT SERVICE

SALARIED POSITIONS. $2,500 to $25,000. This thoroughly organized advertising service of 28 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 260 Delward Bldg., Buffalo, N. Y. (C. M. E.)

POSITIONS WANTED

ANALYTICAL CHEMIST. Mature. Thoroughly experienced, inorganic and organic industrial materials, metals, ores; laboratory management. PW-622, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

ANALYTICAL and RESEARCH CHEMIST. Four years' experience in assaying of common metals and research in development of process industries. Immediately available. No preference as to location. PW-664, Chemical and Metallurgical Engineering, 520 No. Michigan Ave., Chicago, Ill.

CHEMICAL ENGINEER, Reliable, open-minded, 1937 graduate with imagination wants to grow in his profession. Location and salary secondary. PW-665, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

MANUFACTURING CHEMIST has formulated paints, varnishes, printing inks, lacquers and cleansers. PW-666, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

ANALYTICAL CHEMIST who has seven years' experience in heavy chemical making. PW-667, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

POSITIONS WANTED

CHEMIST and CHEMICAL ENGINEER has had work in refining silver, lead, copper and tin. PW-668, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

COMPTROLLER will be available and desires association with a progressive corporation of national reputation. Twenty-five years' experience supervision of controls relative to administrative, financer, takes and general manufacturing problems. Age forty-five years, gentile protestant, married and university education. Exceptional references as to ability and character. PW-669, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

COLLEGE GRADUATE, 1937. Chemist desires position with future. Salary secondary. PW-670, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

CHEMIST: Vegetable or animal oils, laboratory or plant. Capable and willing to assume responsibility. PW-671, Chemical and Metallurgical Engineering, 330 West 42nd Street, New York City.

SPECIAL INSTRUCTION

Evening courses for non-technical business men—Paints, Resins, Metals, Industrial Processes. Classes, New York and Wilmington, starting February. Mail courses. Industrial Consultants, 3404-E Baring St., Phila., Pa.

REPRESENTATIVES WANTED

WANTED—Dealers and distributors for our technical waterproofing concrete compounds, "Volsonite" line. Address P. O. Box 628, Pasadena, California.

SALES ENGINEER

With wide acquaintance among engineers, process and heavy industries wants connection with high grade equipment manufacturer desiring alert representation in Chicago area. Prefer to sell established and proven apparatus on commission basis but will consider other lines.

RA-663, Chemical & Metallurgical Engineering
520 No. Michigan Ave., Chicago, Ill.

FOR SALE

Chemical Periodicals

For sale, back copies of such as Chemical and Metallurgical Engineering, Chemistry and Industry, Journal Chemical Society, Industrial Engineering, Chemistry. B. Login & Son, Inc., 29 East 21st St., New York.

WANTED

PLATINUM SCRAP MERCURY

in any form

We pay highest market price, make prompt returns and hold goods for your approval.

Smelters I. MILLER, INC. Refinery
504 Colonial Arcade Cleveland, Ohio

WANTED

FILTER

We are interested in full particulars on a used Dorrco Filter with complete accessories.

W-649, Chemical & Metallurgical Engrg.
330 West 42nd St., New York City

Wanted—DRYER

Second hand open rotary dryer for drying not less than fifty tons, wet weight, of spent bark, in 24 hours, reducing from 50% to 25% moisture, using stack gases of 300 degrees Fahrenheit. Must be steam driven and in good condition. Give full particulars as to make, type, and size, naming lowest cash price.

PHILIPPINE CUTCH CORP.
500 Fifth Avenue New York, N. Y.

After The Show . . . *What?*

Are you going to act—NOW?

Read what S. D. Kirkpatrick says in an editorial in the November issue of Chemical and Metallurgical Engineering:

"A little time and money spent right now may save you a lot later on. Unless we misread the signs, those who wait much longer than next spring to release their plants for plant expansion and modernization are going to pay higher costs for the privilege of such waiting."

The time to get the proper equipment for plant expansion and modernization is now . . . and the way to get it without delay and without high costs is through "CONSOLIDATED" Our contacts cover the entire process industries field. Our 20 years of experience in buying and selling enables us to pick worthwhile equipment. And our expert reconditioning is the dependable work of experienced "CONSOLIDATED" shopmen, many of whom have been with the company since the beginning . . . one reason why "CONSOLIDATED" equipment is 100% guaranteed to render you profitable service.

The time to buy is NOW . . . the way to buy with confidence is through "CONSOLIDATED". The way to begin 1938 right is to resolve to buy now, and not wait to incur the penalties of delay.

Selected Items

3—24" **Mikro Pulverizers** belt driven.
2—40" Cresson-Morris bronze basket **Centrifugal Extractors,** motor dr., complete with mixers.
1—75 gal. **Nickel Steam Jacketed Agitated Kettle.**
1—Duriron 750-gal. **Jacketed Kettle.**
14—**Aluminum Heavy Gauge Jacketed Kettles,** 52" dia. x 26½" deep, iron stands.
1—**Badger Solvents Recovery Unit,** including 24" copper columns, condensers, dephlegmators, coolers, still pot, complete.
3—**Kelly Filters,** #450, with air motors.
1—Lummus Copper 500-gal. **Jacketed Vacuum Pan.**
1—**Buffalo** 5'x12' **Rotary Vacuum Drum Dryer,** complete with receivers, pumps & piping.
4—**W. & P.** size 30, type X, **Jacketed Mixers,** 2650 gal.
2—100 ton **York Refrigerating Units,** vertical type, each directly connected to 150 hp. synchronous motors, 3/60/440 volt.

1—**Buffalo** J-20 **Vacuum Dryer,** 20 shelves, 60x80".
1—**J. P. Devine,** 5'x33' **Rotary Vacuum Dryers,** complete; 2 Devine 4'x30'.
10—**Devine Vacuum Shelf Dryers,** No. 0, No. 5, No. 1, No. 12, No. 23, No. 26, No. 27, No. 30.
9—**Rotary Vacuum Dryers,** 2x4 ft. Devine; 2x6 ft. Stokes, Devine; 3x10 ft. Buffalo; 3x15 ft. Devine Stokes; 3x25 ft. Devine; 5x15 ft. Buffalo; 5x25 ft. Devine; 5x33 ft. Devine, complete.
1—**Atmospheric Drum Dryer** 5x12'; 1—Mechanical 4x9'; 1—Devine 4x9' Dbl. Drum; 1—Buffalo 48"x40".
8—**Rotary Dryers,** direct heat, 3x20, 4x20, 5x20, 5x30, 6x40, 8 ft. x 60 ft.
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Electric Agitator, 3 H.P.
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Day Chaser Mill, 72" diam; Steel Rolls
Shriver C.I. Filter Press, 30" sq.
Shriver C.I. Filter Press, 42" sq.
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3 Davis Hot Water Heaters, 3'x8'.
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